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# SPORT FISHERY ABSTRACTS

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# DEPARTMENT OF THE INTERIOR

## U. S. FISH AND WILDLIFE SERVICE

## BUREAU OF SPORT FISHERIES AND WILDLIFE

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Prepared in the Division of Fishery Research

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# SPORT FISHERY ABSTRACTS

**An abstracting service for fishery research and management**

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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**13473.** Lee, P. J. 1971. MULTIVARIATE ANALYSIS FOR THE FISHERIES BIOLOGY. Fish. Res. Bd. Canada Technical Report No. 244, 182 p.

An understanding of the ecosystem and its processes involves interpretation of complex interrelations among numerous ecosystem parameters. The aim of ecologists is to quantify their relationships and explain them in terms of causation. Mathematically such an ecosystem may be considered as a set of equations derived from stochastic and/or deterministic processes, explaining relationships of all entities (ecosystem parameters) over space or along time axis. An important strategy of ecosystem analysis is to provide synthesis by systems-oriented mathematical and statistical tools used with high-speed electronic computers. Application of multivariate statistical procedures can greatly strengthen this strategy. This text is based on revised lecture notes for a course given to freshwater biologists at the Institute during 1969. It is hoped that researchers will find the notes useful as an introductory text in the theory and application of some multivariate statistical procedures. An acquaintance with elementary statistics and calculus is assumed. The text starts with a general introductory account of matrix algebra, followed by a chapter on concepts of mathematical statistics. Multiple regression and correlation, principal component, canonical correlation, canonical trend surface, discriminant function, and factor analyses were discussed in subsequent chapters with illustrative examples which were computed at the Institute. Computer programs used in this text are being stored as a library in the IBM System 360/model 65 installed at the University of Manitoba. FORTRAN IV listings and program instructions may be obtained from the Institute. (Auth. preface)

**13474.** Abram, F. S. H. (Water Poll. Res. Lab., Stevenage, England) 1971. AN AIR-ECONOMIZER APPARATUS FOR USE IN FISH WORK. J. Fish Biol. No. 3, pp. 203-205.

Cylinders of compressed air are usually employed to aerate fish stock tanks located away from a source of mains electricity. The apparatus described drives a compressor by extracting some of the energy contained within the high-pressure air from the cylinder by expanding it through an engine, and recovering the power produced. The compressor draws air from the atmosphere to supply a reservoir used to aerate the tanks, at about 0.2 atmospheres. The volume of air obtained is five to six times that available when an air cylinder is connected direct to the aeration system. (Auth.)

**13475.** Allanson, B. R., A. Bok and N. I. van Wyk (Dept. of Zool. and Entom., Rhodes Univ., Grahamstown, South Africa). 1971. THE INFLUENCE OF EXPOSURE TO LOW TEMPERATURE ON Tilapia mossambica Peters (CICHLIDAE). II. CHANGES IN SERUM OSMOLARITY, SODIUM AND CHLORIDE ION CONCENTRATIONS. J. Fish Biol. No. 3, pp. 181-185.

In the cichlid teleost Tilapia mossambica secondary chill coma following exposure to 11°C in freshwater is associated with decreases in plasma osmolarity, sodium and chloride ion concentrations. Fish exposed in seawater diluted to give a NaCl concentration of 5 °/oo show no signs of coma nor are there decreases in osmolarity or sodium and chloride ion concentrations. It is suggested that the restrictions of T. mossambica to estuaries at the southern end of its distribution in southern Africa relates to the maintenance of near normal sodium and chloride ion concentrations at low temperatures during winter. (Authors)

**13476.** Fagade, S. O. (School of Biol. Sciences, Univ. of Lagos, Yaba, Lagos, Nigeria). 1971. THE FOOD AND FEEDING HABITS OF Tilapia SPECIES IN THE LAGOS LAGOON. J. Fish Biol. No. 3, pp. 151-156.

The food of Tilapia mariae (Boulenger), Tilapia guineensis (Bleeker) and Tilapia melanotheron melanotheron (Rupell) were investigated. It is shown that T. guineensis and T. m. melanotheron which were the more abundant species had similar food habits. The intensity of feeding of both species and the possible competition for food between them are discussed. (Auth.)

**13477.** Angiolelli, R. F., and G. J. Rio (Dept. of Biol., St. John's University, Jamaica, New York). 1971. THE SWISS/ICR (Ha) ALBINO MOUSE AS AN EXPERIMENTAL HOST FOR INFECTIOUS PANCREATIC NECROSIS VIRUS OF TROUT. J. Fish Biol. No. 3, 139-144 pp.

Intracranial inoculation of infectious pancreatic necrosis virus (IPNV), a pathogen of several species of trout, produced pancreatic necrosis in suckling Swiss albino mice. Peri-nuclear halos, cytoplasmic vacuoles, and necrosis were found in histologic sections of pancreas taken from mice killed 21 days post-inoculation. Virus was recovered from the pancreas of mice killed as early as 10 days post-inoculation. Rivers' postulates were fulfilled. Virus recovered from the infected mouse pancreas was neutralized by IPNV specific antiserum. The significance of the mouse as an experimental host is discussed. (Authors)

**13478.** Bagenal, T. B. (Freshwater Biol. Assoc., The Ferry House, Ambleside, Westmorland, England). 1971. THE INTERRELATION OF THE SIZE OF FISH EGGS, THE DATE OF SPAWNING AND THE PRODUCTION CYCLE. J. Fish Biol. No. 3, pp. 207-219.

The variability in size of pelagic and demersal marine and freshwater fish eggs is examined. The difference between the smallest and largest volumes, based on published figures for the diameters, is large in many species. In marine species with planktonic eggs, the median percentage difference is just over 100%, and this is similar in species with demersal eggs and in freshwater fish. The available evidence suggests that geographical differences in egg size are small, but in marine fish there is a well-known seasonal decline in egg size. In herring it has previously been shown that egg size in different spawning groups can be correlated with the timing of the production cycle. A similar correlation can be seen in the seasonal shift in time and locality of spawning, and egg size, of the plaice. Sufficient data on seasonal freshwater fish egg variations are not available, but the time of spawning does appear to be linked with the availability of food for the larvae in both lake and stream species. (Auth.)

**13479.** Breder, Charles M., Jr. (Dept. of Ichthyol., The Amer. Mus. of Nat. Hist. & Mote Mar. Lab., Sarasota, Florida). 1968. SEASONAL AND DIURNAL OCCURRENCES OF FISH SOUNDS IN A SMALL FLORIDA BAY. Bull. Amer. Mus. nat. Hist. Vol. 38, Article 6, pp. 329-378.

Studies on fish-produced sounds were made around the clock and through the seasons in a small Florida bay. The dominant sounds were produced by Galeichthys felis and Opsanus beta, and an as yet unidentified species. Less frequently occurring unidentified sounds of considerable variety seemed to be made by transients or strays. Galeichthys produced its "percolator" choruses from April through October, with a summer lull in July and August, never earlier than 5:00 p.m. and never continued later than 10:50 p.m., with a duration ranging from nine minutes to four hours. There was a distinct tendency for Galeichthys to be more sonic during the period near the new moon, a feature less noticeable in Opsanus. Choruses of Galeichthys formed only when the water temperature ranged between 74°F. and 89°F. and began only after the light intensity fell to values of from 1 to 1900 foot-candles. Opsanus produced its "boat-whistle" sound from March to October, with a summer lull from May through July, most vigorous about the time Galeichthys choruses were full, but heard irregularly at all times of day and night. The frequency of the "boat-whistle" of Opsanus varied with water temperature, ranging from about 0.93 sound per minute at 74°F. to about 1.92 sounds per minute at 83°F., with none below 73°F. or above 91°F. The third, but unidentified, sound-producer made its peculiar repetitional soft tapping sound from October to June, with a lull from January through March. This third sound occurred in a temperature range of from 64°F. to 83°F. and with light intensities ranging from zero to 150 foot-candles; no clear relationship to moon phases could be established. An Appendix describes the apparatus used and in some cases developed. (Auth.)

**13480.** Calaprice, J. R. 1970. GENETICS AND MARICULTURE. Fish. Res. Bd. Canada Technical Report No. 222, 10 p.

**13481.** Hellawell, J. M. (Dept. of Zool., Univ. of Liverpool, England). 1971. THE FOOD OF THE GRAYLING Thymallus thymallus (L.) OF THE RIVER LUGG, HEREFORDSHIRE. J. Fish Biol. No. 3, pp. 187-197.

The examination of the stomach contents of 253 grayling from the River Lugg has provided some evidence of a possible depression of feeding activity during the summer months. The diet was varied but bottom food predominated, especially insect larvae, Crustacea and molluscs. Some surface foods were taken but plant material was rarely eaten. Substrate material, detritus and debris and even large pebbles were eaten, mainly in summer. Most seasonal variations in the diet could be related to variations in availability. Fish were not eaten but cyprinid and salmonid eggs were eaten at the appropriate season. In general, increasing amounts of larger food items were eaten by the older grayling. (Auth.)

**13482.** Hines, R., and A. Yashouv (Fish Culture Res. Sta., Ministry of Agric., Dor, Israel). 1971. SOME ENVIRONMENTAL FACTORS INFLUENCING THE ACTIVITY OF SPERMATOZOA OF Mugil capito Cuvier, A GREY MULLET. J. Fish Biol. No. 3, 123-127.

The period of activity of mullet spermatozoa suspended in seawater was similar to that of sperm suspended in osmolar equivalent dextrose solution or artificially prepared seawater. Sperm activity was longest in solutions of pH and osmolarity closely approaching that of normal seawater. Temperatures lower than those at which spawning normally occurs greatly increased the period of activity. Undiluted milt stored at 10°C could be activated by the addition of seawater for a period of 36 h. (Authors)

**13483.** Mathews, C. P. (Zool. Dept., Univ. of Reading, Reading, England). 1971. CONTRIBUTION OF YOUNG FISH TO TOTAL PRODUCTION OF FISH IN THE RIVER THAMES NEAR READING. J. Fish Biol. No. 3, pp. 157-180.

The production of the young stages of four species of cyprinid fish in the River Thames was estimated. From the time when underyearling fish became fully vulnerable to the special fine mesh net used, to the end of their first year, production is 39 $g/m^2$/year compared with 83.3 $g/m^2$/year for fish over 1-year old. The contribution of fecundity to population production varied widely, from 6.1 to 0.4 $g/m^2$/year, but was only a small part of total production. The most productive part of the population was that found between spawning and prior to full vulnerability to the net. Production of this part of the population could be estimated only indirectly and was found to be 58.6 $g/m^2$/year. In the four populations studied production during the first year of life was 66 to 73% of total cohort production in 1967 and only 39 to 64% in 1968. Total fish production in the Thames was estimated at 197 k $cal/m^2$/year; this high result is a consequence of the very high densities found: up to 96.9 $fish/m^2$ were present in August 1967. Ten km of the Thames would contain about 54,000,000 fish in August, falling to around 8,000,000 in winter. The production : biomass ratios for the four species varied from 1.1 to 1.9 in 1967 and from 0.7 to 2.0 in 1968. Very heavy, possibly density dependent, mortality occurs in the first year of life; the annual instantaneous mortality rates are very high, ranging from 6.4 to 8.7. Mortality is heaviest during the first 2 to 3 months after spawning; the instantaneous mortality rates during this period vary from 3.0 to 7.3. (Auth.)

**13484.** Mulcahy, Maire F. (Dept. of Zool., University College, Cork, Ireland). 1971. SERUM PROTEIN CHANGES ASSOCIATED WITH ULCERATIVE DERMAL NECROSIS (UDN) IN THE TROUT Salmo trutta L. J. Fish Biol. No. 3, pp. 199-201.

The total protein level is reduced and the electrophoretic pattern of the serum is changed in trout Salmo trutta L. infected with UDN, as in the Atlantic salmon. However, the changes in the trout are not as characteristic as those in salmon and thus are of very limited use in diagnosis of outbreaks of this disease among trout. (Auth.)

**13485.** Roberts, Ronald J., H. J. Ball, A. L. S. Munro, and W. M. Shearer (Univ. of Glasgow Veterinary School, Glasgow, Scotland). 1971. STUDIES ON ULCERATIVE DERMAL NECROSIS OF SALMONIDS III. THE HEALING PROCESS IN FISH MAINTAINED UNDER EXPERIMENTAL CONDITIONS. J. Fish Biol., No. 3, pp. 221-224.

Fourteen fresh run salmon Salmo salar L. with early extant lesions of ulcerative dermal necrosis (UDN) were kept in separate tanks and treated with zinc free malachite green. Ten of the fish were held at 10°C and 4 at 2°C. The treatment precluded infection with Saprolegnia fungus and allowed natural resolution of the lesions. There was a marked difference in rate of healing between warm and cold water conditions. Histological examination of healing lesions at different stages showed that there was a primary invasion of cuboidal epithelium over the collagen scar followed by a phase of disorganized proliferation which eventually organized itself into normal epithelium. Melanocytes were very obvious in the dermis of healing lesions. (Authors)

**13486.** Western, J. R. H. (Dept. of Zool., Univ. of Leeds, Leeds 2, England). 1971. FEEDING AND DIGESTION IN TWO COTTID FISHES, THE FRESHWATER Cottus gobio L. AND THE MARINE Enophrys bubalis (Euphrasen). J. Fish Biol. No. 3, pp. 225-246.

A comparative study of feeding and digestion in the freshwater Cottus gobio and the marine Enophrys bubalis has been made. The digestion of live prey taken voluntarily, and of aqueous starch suspensions and of olive oil administered by stomach tube, are described at the macroscopic and histological level. Particular attention has been paid to the food capacity of the gut, the mechanical treatment of the food, and the role of mucus in the alimentary tract. Digestion, which is similar in the two species, is divided into three distinct phases, corresponding to the three morphologically separate regions of the post-pharyngeal gut. The relative roles of each of the three regions in the digestion and absorption of food are assessed. No modification of gut structure or function in either species directly attributable to environmental salinity has been detected. The evidence suggests that the faster growth rate of the marine species may be due to the greater digestive-absorptive capacity of its digestive system. (Auth.)

**13487.** Ward, Eileen, S. A. Beach, and E. D. Dyson (Radiobiology Group, Windscale, England). 1971. THE EFFECT OF ACUTE X-IRRADIATION ON THE DEVELOPMENT OF THE PLAICE Pleuronectes platessa L. J. Fish Biol., No. 3, pp. 251-259.

Plaice eggs were irradiated with 80 kV peak X-rays at 5% of their development from fertilization to hatching. The range of doses used was approximately 30-150 rads and the doses were measured with thermoluminescent dosimeters. The percentage hatch of eggs, survival of 3-week old larvae and survival to metamorphosis were noted. The results show that at one of the most radiosensitive stages of development, the $LD_{50}$/metamorphosis for plaice is approximately 90 rads. There is a steep response curve where a dose of 30 rads has little effect and where doses above 150 rads kill the majority of the larvae before metamorphosis. (Authors)

**13488.** Wilson, R. S. (Zool. Dept., Univ. of Bristol, Bristol, England). 1971. THE DECLINE OF A ROACH Rutilus rutilus (L.) POPULATION IN CHEW VALLEY LAKE. J. Fish Biol. No. 3, pp. 129-137.

A series of nettings for roach in Chew Valley Lake carried out by members of the Zoology Department, Bristol University, has revealed a marked decline in the population between 1965 and 1968. Fish from the main Lake were found to be heavily parasitized with Ligula intestinalis (L.) while those from the inflow pool (Herriott's Pool) were practically free from infection. It is considered that the decline of the roach can be linked to the incidence of Ligula, but that clean fish from the inflow pool may provide breeding stock and maintain the production of fry, which serve as food for the trout. (Auth.)

**13489.** Calaprice, J. R. 1970. A PRELIMINARY REPORT ON X-RAY SPECTROMETRIC ANALYSIS AND DISCRIMINATION OF SALMONIDS FROM DIFFERENT GEOGRAPHIC AREAS. Fish. Res. Bd. Canada Technical Report No. 200, 35 p.

Samples of juvenile coho and sockeye salmon were collected from different geographic areas and individuals were characterized by x-ray fluorescence spectrometry. Multiple discrimination analysis of the x-ray fluorescence pattern provided a means of separating groups and determining area of origin. On the basis of computed probabilities of group membership, the individuals were assigned to area of origin without error. The chemical nature of the observed "chemo-print" and the application of the results to problems in population biology, pollution, and numerical taxonomy are discussed. (Auth.)

**13490.** Cooke, R. A., L. D. B. Terhune, J. S. Ford, and W. H. Bell. 1970. AN OPTO-ELECTRONIC PLANKTON SIZER. Fish. Res. Bd. Canada Technical Report No. 172, 40 p.

A device to count plankton in various length categories has been developed by the Engineering Research and Development Group of the Fisheries Research Board of Canada at Nanaimo, British Columbia. Basically, the sizing operation is done by projecting the image of an individual plankter on an array of photosensors as the plankter is carried past the projection point by a fluid stream. Electronic logic circuits decide in which length category the animal should be counted. (Authors introduction)

**13491.** Hunter, J. G. 1970. PRODUCTION OF ARCTIC CHAR (Salvelinus alpinus Linnaeus) IN A SMALL ARCTIC LAKE. Fish. Res. Bd. Canada Technical Report No. 231, 190 p.

Char production in a small arctic lake was investigated from 1962 to 1967. Maximum primary productivity was 2.30 mg $C/m^3$ per day. Cell counts of phytoplankton and dry weight standing stock estimates of zooplankton (1.7 $g/m^2$) and benthos (0.08 $g/m^2$) were low. Char fed principally on zooplankton and insects. Predators were loons and larger char. Most char were mature at age 9 to 10. Instantaneous rates of natural mortality from 0.29 to 2.83 and growth from 0.28 to 0.0 were found for char aged 7 to 17 years. Growth rates increased as the population decreased. Unexploited standing stock of age 7 and older char was 8211 fish weighing 2113 kg (43.5 kg/ha) and the best estimate of equilibrium yield was 6.00 kg/ha. Low productivity of the lake was indicated by a short growing season and low nutrient salt content. Low trophic feeding and lack of competition and predation are important factors promoting good yield. (Auth.)

**13492.** Wiley, Martin L., and Bruce B. Collette (Chesapeake Biol. Lab., Solomons, Maryland). 1970. BREEDING TUBERCLES AND CONTACT ORGANS IN FISHES: THEIR OCCURRENCE, STRUCTURE, AND SIGNIFICANCE. Bull. Amer. Mus. nat. Hist., Vol. 143, Article 3, pp. 145-216.

Evaluation of the nuptial tubercle morphology of the species considered in the present study leads to two general conclusions: (1) The terminology formerly used is of little value in distinguishing between morphologically different types of tubercles. (2) Tubercle morphology has potential use as a character in studies of systematic and phylogenetic relationships of certain groups of fishes. After these two general conclusions are reviewed, an explanation is offered as to why some fishes have tubercles, or contact organs, and some do not. (Authors conclusions)

**13493.** Campbell, A. D. (Freshwater Fish. Lab., Pitlochry, Perthshire, Scotland). 1971. THE OCCURRENCE OF Argulus (CRUSTACEA: BRANCHIURA) IN SCOTLAND. J. Fish Biol. No. 3, pp. 145-146.

Records of the distribution of the genus Argulus in Scotland are given. The occurrence of A. coregoni Thorell in the River Clyde is confirmed. Argulus is comparatively rare in Scotland, as a search of the literature has produced only 5 records during the past 75 years, all of which refer to Argulus foliaceus (L.). In August 1969, some brown trout Salmo trutta L. caught at Thankerton on the River Clyde, were observed to be carrying brown, flattish animals on their skin which were graphically described 'as having the appearance of sheep-keds'. The secretary

of the local angling club, Mr. P. D. McAndrew, sent 2 specimens for identification; these proved to be Argulus coregoni. Both A. foliaceus and A. coregoni are known to occur in England and Wales and may be found on a wide range of fish hosts. It would seem that the distribution of these 2 species in Scotland is confined to an area south of the Central Highlands. It would be of interest to know more about the distribution of both these fish lice, especially in Scotland, and information and specimens would be welcomed. (From auth.)

**13494.** Gehringer, Jack W. (Bur. Comm. Fish. Biol. Lab., Brunswick, Georgia). 1971. YOUNG OF THE ATLANTIC SAILFISH, Istiophorus platypterus. Dept. of Commerce, NOAA, U. S. Fish and Wildl. Serv. Fish. Bull. 68(2): 177-189.

One hundred fifty-four Atlantic sailfish, 26.1 to 216 mm. in standard length, were dip netted on cruises of the Bureau of Commercial Fisheries charter vessel Silver Bay off the south Atlantic Coast of the United States in 1960 and 1962. This group of specimens (larger than any previously available collection of sailfish of similar size) was examined to determine changes during development. Thirty-four eastern Atlantic specimens 13.8 to 238 mm. in standard length that were dip netted in 1968 on a cruise of the Bureau's vessel Undaunted in the Gulf of Guinea were compared with the specimens from the western Atlantic. Five western Atlantic specimens are illustrated. Loss of larval characteristics and development of fins and fin rays and pigmentation are discussed. Correlations of numbers of fin rays and statistics describing relationships of measurements of selected body parts for western Atlantic specimens are presented. Principal differences between eastern and western Atlantic specimens are the slightly longer pectoral fin, snout, and head in eastern Atlantic specimens. (Auth.)

**13495.** Krcma, Richard F., and Robert F. Raleigh (Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1971. MIGRATION OF JUVENILE SALMON AND TROUT INTO BROWNLEE RESERVOIR, 1962-65. Dept. of Commerce, NOAA, U. S. Fish and Wildl. Serv. Fish. Bull. 68(2): 203-217.

Migrations of juvenile chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), sockeye and kokanee salmon (O. nerka), and rainbow trout (Salmo gairdneri) from the Snake and Weiser Rivers and from Eagle Creek were studied. Populations of fish were sampled with floating traps above the reservoir and a fixed louver trap in Eagle Creek near the lower end of Brownlee Reservoir. Age and length of fish, timing of migration, and numbers of fish of native or hatchery origin were determined. This information was needed to evaluate the effect of Brownlee Reservoir on migrations of anadromous fish. (Authors)

**13496.** Durkin, Joseph T., Donn L. Park, and Robert F. Raleigh (Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1971. DISTRIBUTION AND MOVEMENT OF JUVENILE SALMON IN BROWNLEE RESERVOIR, 1962-65. Dept. of Commerce, NOAA, U. S. Fish and Wildl. Serv. Fish. Bull. 68(2): 219-243.

Juvenile salmon—chinook (Oncorhynchus tshawytscha), coho (O. kisutch), and sockeye and kokanee (O. nerka)—were studied. Their rates and direction of movement, spatial distribution, and successful passage to the outlet varied in relation to surface currents, water temperature, and dissolved oxygen concentrations. Some juvenile salmon stayed in Brownlee Reservoir through the summer, fall, and early winter; the percentage varied between years. The percentages were highest in years with high water level and retarded, disoriented flows during the spring migration. Salmon that held over eventually concentrated in rather restricted areas of the reservoir through the summer and early fall, owing to high epilimnion temperatures and to low concentrations of dissolved oxygen that extended into the epilimnion from the hypolimnion. When the water level was low and reservoir currents were oriented downstream, loss of orientation by juvenile salmon was least and movement through the reservoir was most rapid. These reservoir conditions varied, but salmon populations that migrated early in the year were most likely to encounter them. (Authors)

13497. Sims, Carl W. (Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1971. EMIGRATION OF JUVENILE SALMON AND TROUT FROM BROWNLEE RESERVOIR, 1963-65. Dept. of Commerce, NOAA, U. S. Fish and Wildl. Serv. Fish. Bull. 68(2): 245-259.

Floating scoop traps below Brownlee Dam captured samples of marked and unmarked salmon and trout that had left the impoundment from July 1963 through August 1965; estimates of emigration were based on these samples. Success of passage varied among years and populations and was affected by the environment in the reservoir during outmigration. Downstream migrants that entered the reservoir early in the season were more successful than those that entered later. Emigration was also more successful when the reservoir level was low. (Auth.)

13498. Pugh, John R., Gerald E. Monan, and Jim R. Smith (Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1971. EFFECT OF WATER VELOCITY ON THE FISH-GUIDING EFFICIENCY OF AN ELECTRICAL GUIDING SYSTEM. Dept. of Commerce, NOAA, U. S. Fish and Wildl. Serv. Fish. Bull. 68(2): 307-324.

The study was performed in 1962 in a diversion of the Yakima River near Prosser, Wash. Massive structures for regulating the water velocity, producing the desired electrical field, and collecting the guided fish were installed. Evaluation facilities consisted of rotary drum screens to divert all fish that escaped past the electrical field to an inclined-screen trap. The fish tested were wild, downstream-migrating fingerlings of chinook salmon, Oncorhynchus tshawytscha; coho salmon, O. kisutch; and rainbow or steelhead trout, Salmo gairdneri. The variables were three water velocities, three species, and four test periods. Fish-guiding efficiency tended to decrease with increasing water velocity. The guiding efficiencies of the electrical system at water velocities of 0.2, 0.5, and 0.8 (m.p.s.) meter per second were, respectively, 84.2, 54.2, and 50.2 percent for chinook salmon; 82.4, 47.8, and 42.8 percent for coho salmon; and 69.9, 40.2, and 44.8 percent for rainbow or steelhead trout. The guiding efficiency achieved was, thus, highest with chinook salmon, intermediate with coho salmon, and generally lowest with rainbow or steelhead trout. The use of electricity to guide juvenile salmon and trout migrating downstream may be feasible in certain environments where the water velocity does not exceed 0.3 m.p.s. but does not appear practical for use in most rivers and streams. (Authors)

13499. Smith, Lloyd L., Jr., and Donavon M. Oseid. (Dept. of Entomology, Minnesota Univ., St. Paul, Minnesota). 1970. TOXIC EFFECTS OF HYDROGEN SULFIDE TO JUVENILE FISH AND FISH EGGS. 25th Industrial Waste Conf., Purdue, May 6, 1970. Typescript Paper No. 7278. Scientific Journal Series, Minn. Agr. Exp. Sta., 7 p.; Selected Water Resources Abstracts, 4(6): p. 56.

A series of bioassays were conducted with hydrogen sulfide on eggs and fry of walleye pike, rainbow trout, white suckers, and northern pike and on juvenile and adult fathead minnows, bluegills, and walleyes. Various dissolved oxygen levels were used. Fry of the four test species were much more sensitive to hydrogen sulfide than their eggs. In adult and juvenile minnows, bluegills and walleyes the range of tolerance to $H_2S$ was small. Maximum range of levels which permitted 100 percent survival and no survival was from 0.016 to 0.035 ppm in bluegills and the minimum was 0.016 to 0.021 ppm in walleyes. Eggs exposed to $H_2S$ produced the highest number of deformed embryos. Lowered dissolved oxygen levels increases the toxicity of $H_2S$. The authors conclude that the use of 96 hour TLm values for the setting of safe standards for fish life will not be adequate. Longer exposures must be made. -- Sjolseth.

13500. Buss, Keen, and Edward R. Miller (Pa. Fish Comm., Benner Spring Fish Res. Sta., Bellefonte, Pennsylvania). 1971. CONSIDERATIONS FOR CONVENTIONAL TROUT HATCHERY DESIGN AND CONSTRUCTION IN PENNSYLVANIA. Progr. Fish Cult., 33(2): 86-94.

A discussion of water supply, hatchery design, aeration requirements, and water characteristics as factors to consider in reducing hatchery costs, increasing trout production, and eliminating a large percentage of labor by making mechanization feasible and possible.

**13501.** Nunogawa, Jerry H., Nathan C. Burbank, Jr., Reginald H. F. Young, and L. Stephen Lau. (Water Resources Research Center, Hawaii Univ., Honolulu, Hawaii). 1970. RELATIVE TOXICITIES OF SELECTED CHEMICALS TO SEVERAL SPECIES OF TROPICAL FISH. Available from NTIS as PB-196 312, $3.00 in paper copy. Technical Report No. 40, 38 p.; Selected Water Resources Abstracts, 4(6): p. 51.

This study determined the 24, 48, 96-hour median tolerance limit of phenol, DDT, dieldrin, and lindane of five species of fish commonly found in streams and estuaries in semi-tropical areas. They are: (1) Gambusia affinis - mosquito fish, (2) Lebistes reticulatus - guppies, (3) Tilapia mossambica - tilapia, (4) Kuhlia sandvicensis - aholehole, and (5) Stolephorus purpureus - nehu. Of the five species, Gambusia affinis had the highest tolerance to the toxic agents used in this study. Lebistes reticulatus and Tilapia mossambica had approximately the same sensitivity to DDT as well as dieldrin and lindane. Lebistes reticulatus had a higher sensitivity to phenol than Tilapia mossambica. Although Stolepholus purpureus, nehu, was highly sensitive, Kuhlia sandvicensis was most sensitive to all toxic agents used.

**13502.** Dooley, Thomas P. (Prairie View Agr. and Mech. Coll., Texas). 1968. COMPARATIVE EFFECTS OF ABS AND LAS ON THE MOSQUITO MINNOW (Gambusia affinis). The Texas Journal of Science, 20(2): 147-155; Selected Water Resources Abstracts, 4(6): p. 57.

Mosquito minnows (Gambusia affinis) exposed to 0.1% solutions of ABS and LAS were killed within 17 minutes. The survival time increased as the fish were exposed to lower concentrations. Fish reached the cut-off point in LAS at a higher concentration than ABS. This shows ABS to be more toxic than LAS. Four to nine-week old fish succumbed in a shorter period of time than older ones. Females consistently withstood concentrations that were lethal to males. The gills of fish killed by ABS and LAS showed severe damage and in many cases only the skeletal portion of the gills remained. -- Sjolseth.

**13503.** Fowler, Laurie G., and Roger E. Burrows (Bur. Sport Fish. and Wildl., Salmon-Cultural Lab., Longview, Washington). 1971. THE ABERNATHY SALMON DIET. Progr. Fish Cult., 33(2): 67-75.

An open formula dry diet has been developed for salmon (Oncorhynchus). The diet can be made in different particle sizes ranging from a starter granule for first-feeding fish to extruded pellets for larger fish. It is a simplified diet containing fish meal, dried whey product, cottonseed meal, wheat germ meal, a vitamin supplement, and soybean oil, and has proved to be both nutritionally adequate and economically feasible. (Authors)

**13504.** Birdsong, Charles L., and James W. Avault, Jr. (School of Forestry and Wildl. Management, La. State Univ., Baton Rouge, Louisiana). 1971. TOXICITY OF CERTAIN CHEMICALS TO JUVENILE POMPANO. Progr. Fish Cult., 33(2): 76-80.

Acute toxicity of acriflavin, copper sulfate, formalin, and potassium permanganate to juvenile pompano (Trachinotus carolinus) was determined using the toxicity bioassay. The measure of relative toxicity used was the median lethal concentration. This concentration was determined in 24-, 48-, and 96-hour static tests. Five different concentrations of each chemical were tested at salinities of 10, 20, and 30 ppt. The effect of salinity on acute toxicity was measured statistically. The lethal effect of copper sulfate decreased as salinity increased, whereas the toxicity of potassium permanganate increased as salinity increased. Salinity did not affect the toxicity of acriflavin and formalin. Pompano were more resistant to acriflavin, copper sulfate, and formalin than many freshwater fish but were more susceptible to potassium permanganate. (Authors)

**13505.** Kinney, Edward C. (Branch of Coop. Fishery Units). 1970. COOPERATIVE FISHERY UNIT REPORT FOR THE 1969-1970 SCHOOL YEAR. U. S. Dept. of the Interior, Fish & Wildl. Serv., Bur. of Sport Fish. & Wildl. Resource Publication 90, 60 p., illus. For sale by Supt. of Documents, 60 cents.

**13506.** Oseid, Donavon M., and Lloyd L. Smith, Jr. (Dept. of Entom., Fish., and Wildl., University of Minn., St. Paul, Minnesota). 1971. SURVIVAL AND HATCHING OF WALLEYE EGGS AT VARIOUS DISSOLVED OXYGEN LEVELS. Progr. Fish Cult., 33(2): 81-85.

Walleye eggs were hatched at varying levels of oxygen from 2 to 7 ppm and at temperatures from 12.1° to 13.2° C. Length of incubation period varied from 19 days at 7 ppm dissolved oxygen to 22 days at 3 ppm and 12.4° C. At 2 and 4 ppm dissolved oxygen and 13.2° C hatching was complete in 18 and 15 days, respectively. The length of fry at hatch was 5.8 to 12.9% shorter at lower oxygen levels than at higher oxygen levels. When eggs are hatched at low tempeaatures, the difference between different oxygen levels becomes greater. Data suggest that the optimum level for hatching is not lower than 5 to 6 ppm dissolved oxygen. (Authors)

**13507.** Sorenson, LeRoy (Pa. Fish Comm., Corry Pennsylvania). 1971. INJECTION OF CARP WITH DRIED PITUITARY TO CONTROL SPAWNING TIME. Progr. Fish Cult., 33(2): p. 94.

Carp (Cyprinus carpio) offer a partial solution in providing adequate forage for muskellunge culture if their spawning time can be controlled to establish a reliable source of fry. Females were injected at a level of 1 cc to 2 lb body weight with a stock solution of 100 mg of pulverized carp pituitary and 500 mg chloramphenicol activity in 10 cc of sterile water. The fish normally spawned within 12 hr and the eggs produced about a 90% successful hatch.

**13508.** Hoffman, Glenn L., and Robert E. Putz (Bur. of Sport Fish. & Wildl., Eastern Fish Disease Lab., Leetown, West Virginia). 1971. EFFECT OF FREEZING AND AGING ON THE SPORES OF Myxosoma cerebralis, THE CAUSATIVE AGENT OF SALMONID WHIRLING DISEASE. Progr. Fish Cult., 33(2): 95-98.

Rainbow trout fry became infected with Myxosoma cerebralis after the fish were placed in tanks containing mud and spores which had been frozen 2 mo. at -20° C and "aged" 3 to 6 mo. in the tank. No fish in the aquariums without mud became infected. (Authors)

**13509.** Page-Jones, R. M. (White Fish Authority, Marine Fish Cultivation Unit, Hunterston, Ayrshire, Scotland.) 1971. THE AUTOMATIC DETECTION OF LOW LEVELS OF DISSOLVED FREE CHLORINE IN FISH FARMING EXPERIMENTS USING SEAWATER EFFLUENTS. Progr. Fish Cult., 33(2): 99-102.

This paper outlines the method used in an experimental dissolved free chlorine detector that has been in operation about a year. An instrument was developed which would give a clear indication of the level of dissolved chlorine in the form of green, amber, and red lights, representing low (0.03 ppm), high, and alarm (0.3 ppm) levels. A photoelectric colorimetry system based on the D.P.D. method of dissolved chlorine determination gave the best results.

**13510.** Swingle, Wayne E. (Ala. Dept. of Conservation, Dauphine Island, Alabama). 1971. A MARINE FISH CAGE DESIGN. Progr. Fish Cult., 33(2): p. 102.

A cylindrical cage for use in brackish water is constructed of vinyl-coated hardware-cloth, braced by hoop-net rings, and floated by styrofoam blocks. It has a capacity of 28.3 cubic feet and weighs about 20 lb. (Auth.)

**13511.** Heckmann, Richard (Dept. of Biol., Fresno State College, Fresno, California). 1971. PARASITES OF CUTTHROAT TROUT FROM YELLOWSTONE LAKE, WYOMING. Progr. Fish Cult., 33(2): 103-106.

All cutthroat trout (Salmo clarki lewisi) examined during summers 1968 and 1969 had at least 3 species of parasites. Some fish had 6 different parasites, and others had thousands of parasitic protozoans and hundreds of parasitic metazoans. For the fish examined, the average number of parasites was: 6 Salmincola, 4 Piscicola salmositica, 36 Bulbodacnitis scotti, 25 Diphyllobothrium, 38 Crepidostomum farionis, and about 42,000 Trichophyra. This survey yielded 2 new records for protozoans inhabiting the gills and blood of this species. The gill parasite was present in all fish examined; the blood protozoan present in only 1 specimen.

13512. Weber, Don T., and Tom G. Powell (Colo. Div. of Game, Fish and Parks, Fort Collins, Colorado). 1971. BOOM APPLICATOR FOR AQUATIC HERBICIDES. Progr. Fish Cult., 33(2): p. 106.

An inexpensive, portable device for applying aquatic herbicides is constructed from a 30-gal drum. The applicator dispenses an 8-foot-wide swath of herbicide. (Authors)

13513. Meehan, William R. (Forest Service, U. S. Dept. of Agric., Pacific Northwest Forest and Range Exp. Sta., Juneau, Alaska). 1971. EFFECTS OF GRAVEL CLEANING ON BOTTOM ORGANISMS IN THREE SOUTHEAST ALASKA STREAMS. Progr. Fish Cult., 33(2): 107-111.

Sections of streambed in 3 southeast Alaska streams were cleaned with a mechanical "riffle sifter." Bottom fauna populations were sampled before and after gravel cleaning to determine the effect of this operation on fish food organisms. The invertebrate populations were reduced as a result of the cleaning, but they returned to pretreatment levels of abundance within a year. (Auth.)

13514. Mackie, G. L., and S. U. Qadri (Dept. of Biol., Univ. of Ottawa, Ottawa, Ontario, Canada). 1971. A NEW SIEVE AND TUB-TROUGH FOR WASHING SUBSTRATE SAMPLES ABOARD A BOAT. Progr. Fish Cult., 33(2): 112-115.

Reliable results from quantitative investigations of bottom fauna can be achieved by constructing sieves adapted for complete transfer of sieve contents to storage jars. Larger sample volumes can be washed with greater ease when the mesh surface area is increased without a proportionate increase in the overall sieve dimensions. By utilizing a tub-trough the sieves can be used in an open cockpit boat. (Authors)

13515. Patrick, Burton, and Robert Haas (Mich. Dept. of Natural Resources, Wolf Lake State Fish Hatchery, Mattawan, Michigan). 1971. FIN PULLING AS A TECHNIQUE FOR MARKING MUSKELLUNGE FINGERLINGS. Progr. Fish Cult., 33(2): 116-118.

A permanent mark was made on Great Lakes muskellunge (Esox masquinongy masquinongy) fingerlings by extracting the left pelvic fin and a portion of the left side of the pelvic girdle. The fins were pulled on 989 fish of which 2 died during the handling period. There was a 90% return of the marked fish from a 1.3-ha pond. The difference in percent loss between marked and unmarked fish was only 4.8%, and the growth rate was nearly the same for the 2 groups. This marking technique is encouraging and the authors hope to study the survival of marked fish in the wild. (Authors)

13516. Anderson, Emory D., and Lloyd L. Smith, Jr. (Dept. of Entom., Fish., and Wildl., Univ. of Minn., St. Paul, Minnesota). 1971. AN AUTOMATIC BRINE SHRIMP FEEDER. Progr. Fish Cult., 33(2): 118-119.

An automatic feeder that provides continuous feeding of live brine shrimp (Artemia spp.) to lake herring (Coregonus artedii) larvae at regular and frequent intervals during extended periods is described. The size of the feeder, cycle frequency, and volume delivered can be varied. The feeder operates by means of a constant-flow siphon that has as its source a 5-gal jug containing the brine solution.

13517. Whitt, G. S., and J. J. Horowitz (Dept. of Zool., Univ. of Ill., Urbana, Illinois). 1970. EVOLUTION OF A RETINAL SPECIFIC LACTATE DEHYDROGENASE ISOZYME IN TELEOSTS. Experientia, Vol. 26, pp. 1302-1304.

A third genetic locus indicates the presence of a unique isozyme of lactic dehydrogenase functioning only in the neural tissues of teleosts, particularly in the neural retina. The gene function is not manifested in the orders of primitive fishes. These results suggest a difference in retinal metabolism between the teleosts and the classes of more primitive fishes. (Authors resumé in French translated by Robert M. Howland)

13518. Goldwater, Leonard J. 1971. MERCURY IN THE ENVIRONMENT. Sci. Amer., 224(5): 15-21.

Following the discovery of mercury concentrations in fish in Lake Saint Clair, restrictions on fishing and on the sale of fish were imposed in many areas in the U. S. and Canada, and government agencies in both countries began to take action to control the discharge of mercury-containing wastes into lakes and streams. Suddenly, almost overnight, mankind has become acutely fearful of mercury in the environment. Nevertheless, although the recent incidents give us justifiable concern about the potential hazards of mercury in the environment, a panicky reaction would be quite inappropriate. What is now required is detailed investigation of how mercury is being redistributed and concentrated in the environment by man's activities and in what forms and compounds it may be harmful to life. Extensive research on these questions is under way. The natural cycle of circulation of mercury on the earth disperses it widely through the habitable spheres in trace amounts that pose no hazard to life. Our concern, then, must be with any disturbance of the environment that alters the natural balance of mercury in relation to other substances or that generates virulent forms of mercurials. The main threats to which we shall have to give attention are solid and liquid wastes that may ultimately enter bodies of water, thus threatening fish and eaters of fish, and agricultural uses of mercury that may dangerously contaminate food. We do not yet have enough information to estimate the magnitude of these threats or to establish realistic standards of control. A better understanding of what should be considered a toxic level of mercury in the human body is needed. It would be foolish to declare an all-out war against mercury. The evolutionary evidence suggests that too little mercury in the environment might be as disastrous as too much. In the case of mercury, as in all other aspects of our environment, our wisest course is to try to understand and to maintain the balance of nature in which life on our planet has thrived. (From auth.)

13519. Todd, John H. 1971. THE CHEMICAL LANGUAGES OF FISHES. Sci. Amer., 224(5): 98-108.

The bullhead, a predominantly nocturnal animal, has poor vision but highly developed senses of smell and taste. Its nose is almost as keen as the eel's, and its entire body is covered with hundreds of thousands of taste buds. Experiments demonstrated that the chemically sensitive bullheads must use their gift for purposes other than finding food. The yellow catfish, Ictalurus natalis, and the brown catfish, Ictalurus nebulosus, were studied further in this regard. Apparently, the social behavior and recognition of bullheads depend very little on vision. Chemical cues are dominant, and their memory in the recognition of such cues is phenomenal. A few clues to the nature of the chemical signals were uncovered. The odor of the mucus on the fish's skin is sufficient to identify an individual for another bullhead of the same species. This cannot be the whole story, however, because a more intense response is evoked by the water that has bathed the fish, which suggests that other substances are involved. Perhaps the odor of secretions from the gonads serves to identify the fish's sex. The urine also may carry identifying information, although tests of this material show that it alone does not supply enough information for recognition of an individual. Possibly products in the urine indicating the state of stress of the fish may signal whether it is a dominant or a subordinate individual in its community. We are a long way still from deciphering the chemical language of bullheads. It is probably complex, communicating information about the individual's species, status, sex, age or size, reproductive state, individual characteristics and perhaps even family identification. No doubt pheromones are a means of communication between parents and their young. There is evidence that there is some chemical communication between one species and another. Work is in progress to identify the chemical substances that form the languages of fishes. In the not too distant future these substances will be used in pisciculture as selective attractants, artificial baits, growth stimulators, inhibitors of aggression and cannibalism and repellents to deter predators from attacking cultivated fishes. (From auth.)

13520. Zalumi, S. G. (Inst. of Hydrobiology, Ukrainian Academy of Sciences, Kiev, USSR). 1970. THE FISH FAUNA OF THE LOWER REACHES OF THE DNIEPER, ITS PRESENT COMPOSITION AND SOME FEATURES OF ITS FORMATION UNDER CONDITIONS OF REGULATED AND REDUCED RIVER DISCHARGE. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 587-596.

Hydraulic engineering works on the Dnieper have led to an alteration in the water regime of the lower reaches of this river and of the Dnieper-Bug delta which, in turn, has caused an alteration in the composition of the fish fauna: some fish species have disappeared and new ones have appeared. The fishes of the lower reaches of the Dnieper and of the delta are divided into 8 groups in relation to the reaction of alteration of environmental conditions. A table has been compiled of the fish species which have inhabited the lower reaches of the Don and the Dnieper-Bug delta or have periodically entered it before and after the regulation of river discharge. The water regime of the rivers of the Azov-Black Sea, Caspian and Aral basins is being modified in the same direction under the influence of hydraulic engineering works. Given that the fish fauna of the lower reaches of the rivers is similar, changes similar to those which have taken place in the lower reaches of the Dnieper are to be expected.

13521. Solovov, V. P. (Altay Outpost, Novosibirsk Div., Siberian Fish. Res. Inst. (SibNIIRKh), USSR). 1970. BIOLOGY OF THE BREAM (Abramis brama L.) IN THE UPPER REACHES OF THE OB. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 596-602.

The upper Ob system has been successfully stocked with bream from Lake Ubinskoye. The bream has retained a high growth rate in the new body of water. Chironomid larvae provide the bulk of the food of the bream. Data are given concerning the fecundity of the bream, which is shown to be dependent on the age, length and weight of the fish.

13522. Podushko, Yu. N. (Amur Dept., Pacific Res. Inst. for Sea Fish. and Oceanog. (TNIRO), USSR). 1970. THE CONNECTION BETWEEN THE BIOLOGICAL CHARACTERISTICS AND THE POPULATION DYNAMICS OF THE SMELT [Osmerus eperlanus dentex (Steindachner)] SPAWNING IN THE AMUR. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 602-609.

Consideration is given to the relationship between the age, size and weight composition and the condition factor and growth rate of smelts from the spawning populations of 1963-1967, on the one hand, and the abundance of individual year-classes and of the spawning population of a given year, on the other hand. The existence of a correlation between the time at which the spawning migration of the smelt into the Amur begins and the commencement of the spring flood is established on the basis of an analysis of material covering a number of years.

13523. Bitekhtina, V. A. and A. A. Meleshko (Azov Fish. Res. Inst. (AzNIIRKh), Rostov-on-Don, USSR). 1970. A DESCRIPTION OF VIMBA AND SHEMAYA BROOD STOCKS IN HATCHERY PROPAGATION. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 610-618.

A biological description is given of two cyprinid fishes, the vimba (Vimba vimba) and shemaya (Chalcalburnus chalcoides) used for artificial propagation at the Kuban' delta hatcheries. It has been established that up to 95% of vimba and shemaya females produce a first batch of eggs, and that approximately 60-70% give all three batches. Oocyte resorption occurs in the remainder. If oocytes of the trophoplasmic growth stage undergo resorption, the oocytes of the two remaining egg batches develop normally. When the first batch of eggs is normally laid the oocytes of the second batch may undergo resorption in the stage when granular yolk is laid down. Mass maturation of females with a low percentage of resorption of the gonads ensures high fecundity.

**13524.** Rizvanov, R. A. (State Res. Inst. for Lake and River Fish. (GosNIORKh), Leningrad, USSR). 1970. THE SPAWNING BIOLOGY OF THE LAKE LADOGA PIKE-PERCH [Lucioperca lucioperca (L.)] . Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 619-625.

Pike-perch spawning grounds occupy extensive inshore areas of the Volkhov and Sviritsa Bays of Lake Ladoga despite the fact that some spawning grounds have lost their importance. Information is given concerning the depth of the spawning grounds, the spawning substrate, threshold temperatures and the times of spawning. It is shown that the commencement of spawning of the pike-perch coincides with a period of some slackening of winds of the northwesterly quarter, and that its duration is dependent on the total number of windy days in the spawning period. This feature may be used when determining the period for which pike-perch fishing should be banned, which should be established annually. Data are given concerning the age of onset of sexual maturity, the age composition of the spawning stock of the pike-perch, the nature of growth and the proportion of males and females in the spawning grounds.

**13525.** Galkina, Z. I. (State Res. Inst. for Lake and River Fish. (GosNIORKh), Leningrad, USSR). 1970. DEPENDENCE OF EGG SIZE ON THE SIZE AND AGE OF FEMALE SALMON [Salmo salar (L.)] AND RAINBOW TROUT [Salmo irideus (Gib.)] . Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 625-633.

Consideration is given to the effect of the size and age of female rainbow trout, Baltic salmon and White Sea salmon (Atlantic salmon) on the size of their eggs. Considerable variability in the weight of the eggs was established. The weight was found to be greatest in the trout and least in the Baltic salmon. The White Sea salmon occupied an intermediate position. The mean weight of an egg of each individual female falls within the limits characteristic for the species concerned irrespective of the age and size of the females. However, the smallest eggs were found only in some of the small fishes, and the largest only in some of the average-sized or large females. The proportionate effect of the size and age of the females on the mean weight of their eggs (by unifactorial complex) was, for all the species, approximately a third of the total effect of all the factors ($\eta^2 \approx 0.3$).

**13526.** Dmitrenko, Ye. M. (Azov-Black Sea Res. Inst. for Sea Fish. and Oceanog. (AzCherNIRO). 1970. REPRODUCTION OF THE SEA CATFISH [Arius thalassinus (Rupp.)] IN THE ARABIAN SEA. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 634-641.

General information is given concerning the spawning grounds and time of spawning of the sea catfish Arius thalassinus (Rupp.) in the Arabian Sea. Consideration is given to the conditions, nature and duration of spawning, to changes in oocyte diameter and to the coefficients of maturity of the fish in different periods of the year. It has been established that the female catfishes lay several egg batches on the silty bottom during the breeding period. Each egg batch is an adhesive cluster of 23-67 eggs typically 16 mm, less frequently 17-20 mm, in diameter. Empty follicular membranes and a large quantity of small 'yolkless eggs', reduces the specific gravity of the cluster and thus prevents it from sinking into the ooze. Brood care is effected by the male, who incubates in the oral cavity a quantity of eggs equal to a spawning batch.

**13527.** Sytina, L. A. (A. N. Severtsov Inst. of Evol. Morph. and Animal Ecology, USSR Acad. of Sci. (IEMEZh), Moscow, USSR). 1970. THE DURATION OF THE INDIVIDUAL DEVELOPMENT STAGES IN THE EARLY POSTEMBRYOLOGY OF STURGEONS. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 641-651.

Consideration is given in the paper to the problem of variation in the length of individual development stages and in the total length of the period of endogenous nutrition during the embryonic development of different sturgeon species under similar conditions. The length of development was measured in days and hours, as percentages of the total length of the period of endogenous nutrition, in degree-hours

and in the number of cell generations. The length of individual development stages is not a constant, but varies not only between species, but also in larvae of the same species.

13528. Tsunikova, Ye. P. (Azov Fish. Res. Inst. (AzNIIRKh), Rostov-on-Don, USSR). 1970. DAILY FOOD CONSUMPTION OF YOUNG PIKE-PERCH AND AZOV ROACH (TARAN) IN THE KUBAN FISH FARMS. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 658-662.

The rate of digestion of food, the daily feeding pattern and the mean daily fullness of the alimentary canal of young Azov roach and pike-perch have been determined. In natural bodies of water daily food consumption is dependent mainly on water temperature and on the biomass of food organisms. It has been established that young pike-perch were fully supplied with food only in stage B and that in all the remaining development stages they consumed 2-2.5 times less food than the theoretical requirement. The actual daily food consumption of young Azov roach in almost all development stages was considerably above the theoretical consumption, which indicates the possibility of increasing its abundance per unit of growth area.

13529. Shcherbina, M. A., V. F. Mochul'skaya and Ye. Z. Erman (All-Union Pond Fish. Res. Inst. (VNIIPRKh), Rybnoye Postal District, Moscow Province, USSR). 1970. STUDY OF THE DIGESTIBILITY OF THE NUTRIENTS IN ARTIFICIAL FOODS BY POND FISHES. COMMUNICATION I. DIGESTIBILITY OF THE NUTRIENTS OF PEANUT OIL MEAL, PEAS, BARLEY AND FEED MIXTURE BY TWO-YEAR-OLD CARP. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 662-667.

Data concerning the digestibility by two-year-old carp of crude protein, hydrolyzable carbohydrates, the total quantity of lignin and cellulose, crude lipid, and also the amounts of available calcium, magnesium and phosphorus and the total sum of nutrients in peanut oil meal, peas, barley and feed mixture were obtained by the method of inert substances.

13530. Kogan, A. V. (Volgograd Dept., State Res. Inst. for Lake and River Fish. (GosNIORKh), USSR). 1970. THE FOOD RESOURCES OF TSIMLYANSK RESERVOIR AND THE EXTENT OF THEIR UTILIZATION BY COMMON FISH SPECIES. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 667-674.

The production of the principal groups of the benthos and nektobenthos in 1959-1963 was intensively consumed by the common fish species of Tsimlyansk reservoir. The degree of utilization of these groups of the food resources varied: it was 17-18% in 1959-1960 and 42-46% in 1962-1963. The sharp increase in food consumption by benthophages was a consequence of the abundant development of Monodacna in the body of water. Calculations made of the calorific value of food items made it possible to establish that the main food group in the reproduction of the fish biomass was lower crustaceans in 1959, higher crustaceans in 1960 and 1962, and Monodacna in 1963.

13531. Ipatov, V. V. (Baltic Fish. Res. Inst. (BaltNIIRKH), Riga, Latvia). 1970. THE DYNAMICS OF BLOOD SERUM PROTEINS OF THE BALTIC COD (Gadus morhua calarias L.) IN RELATION TO THE MATURITY OF THE SEXUAL PRODUCTS AND TO THE SEASON. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 674-677.

The protein composition of the blood serum of the Baltic cod was investigated by the method of electrophoresis on agarose. The research was conducted on fish with gonads in different stages of maturity in the course of the annual cycle. Absence of $\gamma$ globulin from the blood serum was noted; it was assumed that $\beta$ globulin was involved in antibody formation. The changes occuring in the protein fractions of the serum in the course of maturation of the gonads were more profound in females than in males.

**13532.** Ivanova, M. N., I. Ye. Permitin, and S. N. Polovkova (Inst. of the Biol. of Inland Waters, USSR Acad. of Sci., Borok Postal District, Yaroslavl' Province, USSR). 1970. SEASONAL DISTRIBUTION FEATURES OF THE ADULT LANDLOCKED SMELT (SNETOK) [Osmerus eperlanus eperlanus morpha spirinchus Pallas] IN THE VOLGA REACH OF RYBINSK RESERVOIR. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 678-684.

The landlocked smelt (snetok) population of the Volga reach of Rybinsk Reservoir (young and adults) keeps to one area (the estuarine area of the reach) only in the summer. At other times of the year the individual age and size groups of the population are spatially isolated. Small (young) fish inhabit the lake portion, while larger and older fish ascend the river portions of the reach. In mode of life the young snetok may be classified as a lacustrine smelt; the adult part of the population of the Rybinsk snetok is, under the existing classification, a typical lake-river form of the smelt.

**13533.** Mikheyev, P. V., Ye. V. Meysner and V. P. Mikheyev (All-Union Pond Fish. Res. Inst. (VNIIPRKh), Rybnoye Postal District, Moscow Province, USSR). 1970. THE IMPORTANCE OF CONTACT WITH THE AIR IN THE LIFE OF THE RAINBOW TROUT. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 691-693.

In order to clarify the reasons for the death of rainbow trout in submerged containers during winter, a series of experiments was conducted to delineate the effects of the nature of flow, low-water temperature, oxygen content, the feeding rate and the composition of food. None of these experiments provided an answer to the question of the reasons for the death of the trout in the containers. Then parallel experiments were conducted in which trout were kept in winter containers in the reservoir and in tanks in a heated house. In the winter containers in the reservoir, the trout tended to the surface, began to swim on their sides, lay on the bottom and perished. No such pattern was observed in the tanks in the house where the water surface was open: all the trout swam normally and survived. Trout which were swimming on their sides in the container rapidly recovered and began to swim normally when transferred to a tank in the house. Even a trout which lay on the bottom of the container and had sores on its body began to swim. The trout also recovered rapidly when a container completely submerged in the water was raised to the surface. When the container was raised to the surface the same behavior was noted as when the trout were transferred from the container to the tank; on gaining access to the air, the trout initially swallowed air intensively, and then began to swim normally. The experiments showed vividly that contact with the air is of very great importance in the life of the trout.

**13534.** Solov'yev, L. G., and G. I. Tolchinskiy (All-Union Pond Fish. Res. Inst. (VNIIPRKh), Rybnoye Postal District, Moscow Province, USSR). 1970. THE USE OF THE POLAROGRAPH FOR OBSERVING OXYGEN CONDITIONS DURING EGG INCUBATION. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 694-697.

A polarograph was used to study the oxygen conditions under which fish eggs develop in a Weiss type incubator. Use was made for this purpose of an instrument adapted from a IOAN oxymeter (model 0-63) with two probes: one at the entrance to and the other at the exit from the incubator. The instrument was tested in 1966 at the Goryachiy Klyuch Fish Hatcheries (Krasnodar Territory). Studies were made of the oxygen conditions under which silver carp and bighead eggs developed in an incubator constructed from a 1.5 liter separatory funnel. Control samples of water for Winkler analysis were taken four times at the entry to and exit from the incubator in the course of each experiment. The difference in oxygen determination by the instrument and by the chemical method did not exceed 0.03 ml/liter. The experiments show that the instrument tested ensures continuous and relatively accurate observation of the oxygen conditions of egg development in the incubator. Such oxymeters may be used as aerator feedback probes in the development of systems for the automatic control of oxygen regime.

13535. Kozlov, Yu. P., B. N. Tarusov, V. I. Chernyshov, and S. M. Yakubov (Dept. of Biophysics, Biol. and Soil Faculty, Moscow State Univ., USSR). 1970. CHANGES IN THE PHYSIOCHEMICAL PROPERTIES OF ENDOGENOUS LIPIDS IN FISHES SUFFERING FROM INFECTIOUS DISEASES. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 697-700.

It seemed to be of interest to delineate the characteristic changes in a number of fish tissues affected by infectious disease, in particular infectious dropsy of carp. The antioxidant activity (AOA) of endogenous lipids isolated from a number of tissues of sick and healthy fish was investigated. The content of oxidation products (peroxides) of the same lipids and the toxic properties of the lipids were studied. For the liver and spleen of the diseased fish the IA of the lipids and, consequently, their AOA, is little more than a half that of lipids isolated from similar organs of healthy fish. Whereas in healthy fish the IA level of spleen lipids is found to be greater than the IA level of liver lipids in sick fish, conversely, the IA level of liver lipids is higher than the IA level of spleen lipids. The reduction of lipid antioxidants in the liver and spleen of sick fish is directly reflected in the yield of loosely bound lipids in their extraction from these organs. Their yield from the tissues of sick fish is 1.5-2 times lower than in the case of healthy fish. Difference in the induced luminescence of lipids isolated from the gills of sick and healthy fish was determined. For this purpose these lipids were dissolved in chloroform in a concentration of 2 mg/ml and added to oleic acid oxidizing at 80°C. It was found that the height of the burst of luminescence of oleic acid observed when the gill lipids of the sick fish were added was less than a half that observed in the case of healthy fish. In the liver and in the gills of the sick fish peroxide concentration was higher than in the corresponding tissues of the healthy fish and this excess was most clearly expressed in the gills of the sick fish. It may be concluded that free radical processes play an active role in the picture of disease. Increase in the intensity of free radical reactions leads to continuous poisoning of the fish body by the cytotoxic products of these reactions, 'autotoxins', which are apparently one of the reasons for the death of the fish.

13536. Osipova, V. B. (Dept. of Zool., Ul'yanovsk Pedagogical Inst., USSR). 1970. AGE AND SIZE COMPOSITION OF WILD CARP SPAWNERS IN THE CHEREMSHAN ARM OF KUYBYSHEV RESERVOIR. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 700-703.

Due to the uneven conditions of reproduction, feeding and overwintering there are sharp differences in the abundance of wild carp of different year-classes. The 1956 and 1957 year-classes were the most abundant. The 1958, 1961 and 1962 year-classes were of average strength, the 1963 and 1964 year-classes were very weak and the 1959 and 1960 year-classes were very weak. A combination of fish management, improvement and conservation measures to ensure normal conditions for the reproduction, feeding and overwintering of this fish must be carried out if commercial stocks of the wild carp are to be created. These measures are: a high and stable water level must be maintained during spawning; draw down below the 50 m mark must not be permitted in the winter or improvement works must be carried out in the shallow water zone and water level must not be lowered below 48.5 in the winter; the Ulyanovsk hatchery in Cheremshan Bay must be brought into use.

13537. Matyukhin, V. A., V. V. Khaskin, and A. Ya. Stolbov (Inst. of Physiology, Siberian Dept., USSR Acad. of Sci., Novosibirsk, USSR). 1970. A DEVICE FOR COMBINED STUDY OF THE ENERGY EXPENDITURE AND PHYSIOLOGY OF SWIMMING IN FISHES. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 703-706.

The authors have designed and manufactured an apparatus for combined study of a number of characteristics of the energy metabolism and hydrodynamics of swimming fishes. The apparatus has been tested in a large number of experiments during two years of use both under laboratory and under expedition conditions.

**13538.** Shterman, L. Ya. (State Res. Inst. for Lake and River Fish. (GosNIORKh), Leningrad, USSR). 1970. METHEMOGLOBIN IN FISH BLOOD. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 709-712.

The object of the present paper was to detect and give quantitative expression to methemoglobin in the blood of certain fishes reared in ponds and lakes, relating methemoglobin content to age-related and ecological features. Use was made in the study of underyearling and yearling carp, rainbow trout 2+ years old, and pelyad 2+ years old. Before being placed in the overwintering pond the underyearling carp were given food containing supplements: 5% fodder yeast ('Y'), 5% phosphatide-lecithin ('P'), and a control ('C') without supplements. Determinations made in the fall months when the fishes were mobile and fed actively showed that methemoglobin was present in the blood of all the fishes investigated. Its quantity was found to be different in different species: 2.7-3.1% in the trout and the pelyad and 8.0-8.8% in the carp. These differences may be explained by the more active mode of life of the trout and the pelyad and therefore have adaptive significance. The age of the fish (underyearling or yearling carp) was not of significance. However, definite age differences were detected in the carp during overwintering. The amount of methemoglobin in the blood of yearling carp remained practically constant throughout the entire winter and no mortality of the fish was observed at this time. In underyearlings of the control group 'C', a considerable increase of methemoglobin content in the blood (practically twofold) was noted, beginning with January. Great loss of these fish, up to 80%, was simultaneously observed in the course of overwintering. In the carp of group 'Y' the increase of methemoglobin content in the blood in January and in March did not differ significantly from that in the control fish. In carp of the 'P' group methemoglobin increased by a considerably lesser amount, differing significantly from the control. The loss of fish of this group during overwintering was also less (41.9%). The lack of an increase of methemoglobin content in the blood of yearling carp indicates that this phenomenon is characteristic only of the 'juvenile' period of their life. Content is higher in older than in younger erythrocytes.

**13539.** Kulikova, O. S. (All-Union Experimental Veterinary Inst. (VIEV), USSR). 1970. THE HISTOLOGIC STRUCTURE OF THE GILL FILAMENTS IN ADULT CARP. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 712-714.

Research was conducted on 14 adult carp (males and females). It was established that the apical part of the respiratory folds in adult carp is thickened and lined with a multilayered flat epithelium. Round structural formations found in this part of the gill filaments consisted of elongated cells of two forms differing in the structure of the nuclei. In some cells the nuclei were succulent and oval; on others they were compact and filiform. Goblet cells were discovered deep within the folds of the respiratory epithelium which were morphologically similar to the protein-secreting cells of the salivary glands of mammals. They had a light cytoplasm and a compact, basally situated lenticular nucleus. The cytoplasm was filled with a secretion containing mucopolysaccharides revealed by Schiff's reagent as fine threads. The results of the histologic studies suggest that the function of the gills in the adult carp is not confined to the maintenance of the required oxygen regime but is more complicated.

**13540.** Pikhu, E. Kh., and E. R. Pikhu (Inst. of Zool. and Botany, Estonian Acad. of Sci., Tartu, Estonia). 1970. RECONSTRUCTION OF THE SIZE OF FISHES SWALLOWED BY PREDATORS FROM FRAGMENTS OF THEIR VERTEBRAL COLUMN. Journal of Ichthyology, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp., 10(5): 706-709.

**13541.** Floyd, Hilton M. (Exploratory Fishing and Gear Res. Sta., So. Atlantic Fisheries Explorations, Brunswick, Georgia). 1971. A LIFT NET FOR CATCHING BAIT FISH ATTRACTED TO LIGHT. Dept. of Commerce, NOAA, NMFS Fishery Leaflet 638, 3 p., illus.

Construction and operation of the gear are described. The chief attributes of the gear are its light construction and single-handed operation. (Auth.)

13542. Hamelink, Jerry L., Ronald C. Waybrant, and Robert C. Ball (Dept. of Fish. and Wildl., Michigan State Univ., East Lansing, Michigan). 1971. A PROPOSAL: EXCHANGE EQUILIBRIA CONTROL THE DEGREE CHLORINATED HYDROCARBONS ARE BIOLOGICALLY MAGNIFIED IN LENTIC ENVIRONMENTS. Trans. Amer. Fish. Soc., 100(2): 207-214.

The dynamics of DDT in lentic environments were studied in a farm pond and four artificial pools. A hypothesis that biological magnification of pesticides was dependent on passage of the residues through a food chain was rejected and a hypothesis that accumulation depends on adsorption and solubility differences was proposed. The mechanism proposed is based on the principle that compounds are exchanged between water and fats. Exchange in fish passes through two stages, from water to blood and from blood to fats, permitting a high degree of magnification in fish. The proposed mechanism accounts for the reported observations that pesticides are excreted by fish, that body load of pesticides increases as the fat content of fish increases, that pesticide magnification by fish is inverse to the water solubility of the compounds and that pesticides persist longer in oligotrophic than eutrophic lentic ecosystems. (Authors)

13543. Grzenda, Alfred R., William J. Taylor and Doris F. Paris (Fed. Water Qual. Admn., Southeast Water Lab., College Sta. Rd., Athens, Georgia). 1971. THE UPTAKE AND DISTRIBUTION OF CHLORINATED RESIDUES BY GOLDFISH (Carassius auratus) FED A $^{14}$C-DIELDRIN CONTAMINATED DIET. Trans. Amer. Fish. Soc., 100(2): 215-221.

When goldfish (Carassius auratus) were fed at regular intervals with $^{14}$C-dieldrin contaminated food, they exhibited a rapid initial uptake of radioactivity followed by a period in which the uptake rate was considerably reduced. The concentration of radioactivity in the tissue was found to increase continuously during the course of the investigation. Tissues from fish fed on a diet containing a high concentration of dieldrin were shown to accumulate higher concentrations of radioactivity and at greater rates than those exposed to a lower concentration of toxicant. It was also found that tissues from fish exposed to the lower dieldrin concentration took up a higher percentage of the available radioactivity than did tissues from fish exposed to higher concentrations. Analysis of individual tissues revealed that, in all cases, mesenteric adipose tissue and testes contained the highest concentrations of radioactivity, while muscle and blood had the lowest. Thin-layer chromatography of tissue extracts failed to reveal any radioactive metabolites derived from dieldrin. (Authors)

13544. Tarrant, Robert M., Jr. (Southeastern Fish Cult. Lab., Marion, Alabama). 1971. SEASONAL VARIATION IN THE ACCUMULATION AND LOSS OF $^{131}$I BY TISSUES OF ADULT FEMALE CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). Trans. Amer. Fish. Soc., 100(2): 237-246.

At bimonthly intervals over a 10-month period, adult female channel catfish were injected intraperitoneally with a tracer dose of $^{131}$I. Four fish were killed and dissected each day at intervals of 1, 5, 9, and 13 days after injection, and radioactivity in various tissues was determined. The ovary (entire organ) concentrated more $^{131}$I throughout most of the year than even the very active thyroid area, accumulating over 70% of injected $^{131}$I during both January and March. Accumulation of $^{131}$I by the ovary increased from July to March and then decreased in May, although the size of the ovary continued to increase. Concentration of $^{131}$I by the thyroid area throughout most of the year varied inversely with accumulation by the ovary. Accumulation of $^{131}$I by sexually undeveloped fish in May was similar to that of spawned-out fish in July. Strong similarities were also found between sexually developed fish in May and unspawned fish in July. The maximum amount of $^{131}$I in the ovary within each sampling period occurred on the fifth day after injection, except in July and September when it occurred on the first day. The level of $^{131}$I in the blood was highest on the first day after injection. The concentration of $^{131}$I in the thyroid area expressed as microcuries per gram of tissue much more closely paralleled percentage of injected dose than did the ratio of tissue $^{131}$I to blood $^{131}$I. The only portions of the channel catfish body which consistently accumulated $^{131}$I against a concentration gradient were the thyroid area, ovary, bile, and gut contents.

Highest concentrations in the bile and gut contents occurred in May. (Auth.)

13545. Wadley, Gerald W., and Arthur D. Welander (Coll. of Fish., Univ. of Wash., Seattle, Washington). 1971. X-RAYS AND TEMPERATURE: COMBINED EFFECTS ON MORTALITY AND GROWTH OF SALMON EMBRYOS. Trans. Amer. Fish. Soc., 100(2): 267-275.

Four embryonic stages of chinook embryos were irradiated with graded, acute doses of X-rays (15 to 1530 r), in duplicate experiments, one at ambient temperature, the other at 2 C above ambient. The effects of temperature, irradiation and handling were evaluated in terms of growth and mortality. Growth stimulation attributable to low dose irradiation was observed at both temperatures but was more apparent at the ambient temperature. (Authors)

13546. Stucky, Norman P., and Harold E. Klaassen (Div. of Biol., Kansas State Univ., Manhattan, Kansas). 1971. GROWTH AND CONDITION OF THE CARP AND THE RIVER CARPSUCKER IN AN ALTERED ENVIRONMENT IN WESTERN KANSAS. Trans. Amer. Fish. Soc., 100(2): 276-282.

This study was designed to assess the populations of the carp, Cyprinus carpio Linnaeus, and the river carpsucker, Carpiodes carpio (Rafinesque), in Cedar Bluff Reservoir, and the Smoky Hill River, west-central Kansas. Three variables – (1) growth rate, (2) condition factor, and (3) percentage fat content – were used to evaluate the two populations. Data were collected from the spring of 1967 to the fall of 1968. Mean calculated lengths of carp at different ages in the reservoir were comparable to lengths of fish in the river. The growth of the carpsucker was slightly greater in the reservoir than in the river. The condition coefficients of carp in the river were significantly higher than those of carp in the reservoir, but no significant differences existed between carpsucker in the two environments. The percentage fat content of carp from the river was significantly greater than that in the carp from the reservoir, but the percentage fat content of the carpsucker from the two environments was not significantly different. The higher fat content and the more robust condition of the carp in the river indicated that this environment was more suitable than the reservoir for this species. The slightly increased growth rate of the carpsucker in the reservoir and the similarity of the other data imply that the reservoir may be a slightly more suitable habitat than the river for this species. (Authors)

13547. Barber, Willard E., and W. L. Minckley (Dept. of Zool., Arizona State Univ., Tempe, Arizona). 1971. SUMMER FOODS OF THE CYPRINID FISH Semotilus atromaculatus. Trans. Amer. Fish. Soc., 100(2): 283-289.

Aquatic larvae and pupae, fishes, and molluscs together contributed 95% of the stomach contents of creek chubs from headwaters of the Mississippi River, Clearwater County, Minnesota, during the summer of 1965. As fish grew the changes in food items were from ephemeropteran nymphs and smaller dipterans to larger caddisfly and dipteran larvae, and then fishes. Chubs feed generally in proportion to availability of food organisms. Fishes fed most intensively during early evening and least in the morning. As summer progressed, a reduction in feeding intensity occurred. (Authors)

13548. Lewis, Robert M., and Walter C. Mann (NMFS, Center for Estuarine and Menhaden Research, Beaufort, North Carolina). 1971. OCCURRENCE AND ABUNDANCE OF LARVAL ATLANTIC MENHADEN, Brevoortia tyrannus, AT TWO NORTH CAROLINA INLETS WITH NOTES ON ASSOCIATED SPECIES. Trans. Amer. Fish. Soc., 100(2): 296-301.

A comparison was made of relative indexes of abundance for Atlantic menhaden larvae entering two North Carolina inlets. Larvae entered the inlets from November through April 1966-67 and 1967-68, and were most abundant in March during both survey periods. Collections over 24 hours showed that larvae are more abundant in the slower tidal currents. As the larvae drift back and forth on the ebbing and flooding currents and feed on plankton, their condition factors (weight/length$^3$) increase. The abundance of 23 other species of fish collected with the menhaden is also discussed. (Authors)

13549. Boothby, Rea N., and James W. Avault, Jr. (Fish. Div., School of Forestry and Wildlife Management, La. State Univ., Baton Rouge, Louisiana). 1971. FOOD HABITS, LENGTH-WEIGHT RELATIONSHIP, AND CONDITION FACTOR OF THE RED DRUM (Sciaenops ocellata) IN SOUTHEASTERN LOUISIANA. Trans. Amer. Fish. Soc., 100(2): 290-295.

A total of 349 adult red drum (Sciaenops ocellata) were collected from the coastal marsh below Hopedale in southeastern Louisiana, between October, 1967 and October, 1968. A total of 286 fish (82%) contained identifiable food items which were analyzed as to frequency of occurrence and percent of total volume. The main food items in order of occurrence were fish, shrimp, and crabs. Blue crabs, mud crabs, and penaeid shrimp were the crustaceans most frequently eaten, and at least 14 different species of fish were utilized to some degree. Food habits varied substantially from season to season. Fish was the main food item during winter and spring months. Crustaceans, crabs and shrimp combined comprised the bulk of the diet during the summer and fall months. Only slight differences in food habits were detected due to size or sex. Gonadal examination of eight adults indicated that spawning took place between September and December. The length-weight relationship and seasonal condition values were determined. Red drum of a given standard length were generally heavier than previously reported. Condition values from this study represented fish in overall good condition. (Authors)

13550. Armstrong, Robert H. (Alaska Dept. of Fish and Game, Sport Fish Div., Juneau, Alaska). 1971. AGE, FOOD, AND MIGRATION OF SEA-RUN CUTTHROAT TROUT, Salmo clarki, AT EVA LAKE, SOUTHEASTERN ALASKA. Trans. Amer. Fish. Soc., 100(2): 302-306.

Information was collected on sea-run cutthroat trout (Salmo clarki) from the Eva Lake system on Baranof Island, Southeastern Alaska. Migrations of 1,210 to 1,594 out-migrants and 1,203 to 1,682 in-migrants were recorded at a weir across the outlet of Eva Lake. Migration peaks occurred in mid-May (out-migrants) and mid-September to early October (in-migrants). No movement of cutthroat was noted at the weir from December through February. Ages of out-migrant cutthroat ranged from 3 to 10, with the majority showing 5, 6, and 7 annuli on their otoliths. The numbers of annuli considered to be formed prior to smolt migration were 2 (3%), 3 (80%) and 4 (17%). Stomach contents consisted primarily of salmon young and insects during the summer and stickleback and insects during the winter in Eva Lake. The fish fed mostly on insects during their out-migration and amphipods and salmon young in salt water. Results of the Eva Lake study and other studies on sea-run cutthroat are compared. (Auth.)

13551. Mathur, Dilip, and Timothy W. Robbins (Ichthyological Associates, P. O. Box 12, Drumore, Pennsylvania). 1971. FOOD HABITS AND FEEDING CHRONOLOGY OF YOUNG WHITE CRAPPIE, Pomoxis annularis Rafinesque, IN CONOWINGO RESERVOIR. Trans. Amer. Fish. Soc., 100(2): 307-311.

In Conowingo Reservoir most of the food consumed by young white crappie over one 24-hour period was eaten during daylight hours, most of it during the morning and early afternoon. The maximum number of organisms was present during mid-afternoon. Daphnia spp. and Cyclops spp. were the most important food items. The consumption of these items changed significantly over the 24-hour period of study. It was estimated that the food items eaten by young white crappie passed through the stomach in 14 to 17 hours. Data on seasonal food studies of young white crappies indicated that they fed exclusively on zooplankton in most months. Daphnia spp. were important in the diet in June through October. Cyclops spp. were important in September through April. Chironomid larvae and pupae were most eaten in April and May. Bosmina sp., Leptodora sp., Alona sp., amphipods, mayfly nymphs, and algae were also eaten seasonally in small quantities. The diet was more varied in late fall, winter, and early spring months than in the summer. Feeding activity was highest in May through October. (Authors)

13552. Priegel, Gordon R., and Thomas L. Wirth. 1971. THE LAKE STURGEON. ITS LIFE HISTORY, ECOLOGY AND MANAGEMENT. Wis. Dept. of Natural Resources, Publication 240-70, 20 p. illus.

13553. Dodge, Douglas P., and Hugh R. MacCrimmon (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1971. ENVIRONMENTAL INFLUENCES ON EXTENDED SPAWNING OF RAINBOW TROUT (Salmo gairdneri). Trans. Amer. Fish. Soc., 100(2): 312-318.

Variations in discharge and water temperature influenced movements of spawning rainbow trout between Lake Huron and Bothwell's Creek. Adults entered the stream between 29 October and 15 May, with numerical peaks in late December, and between 16 February and early April, following major freshets and associated rising water temperatures. Between 31 January and 13 February, during a period of minimal stream discharge and low water temperatures to 0.3 C, no new fish entered the stream, but spent and spawning-scarred fish moved downstream, and disappeared after a mid-February freshet. Spent trout of the later run moved downstream during late April and early May. Spawning occurred first on 27 December in the upper reaches at 6 C, and by early January elsewhere in the stream. Activity increased with rising water temperatures, peaking during late March and early April at water temperatures of 6 to 8 C. Aborted attempts at spawning occurred on 2 June. Viable eggs resulted from December and January spawning at water temperatures of 0.3 and 2.0 C. (Authors)

13554. Liscom, Kenneth L. (Nat. Mar. Fish. Serv., 2725 Montlake Blvd. East, Seattle, Washington). 1971. ORIFICE PLACEMENT IN GATEWELLS OF TURBINE INTAKES FOR BYPASSING JUVENILE FISH AROUND DAMS. Trans. Amer. Fish. Soc.,100(2): 319-324.

Four locations of an orifice within a turbine intake gatewell were tested to determine which was the most effective in facilitating the passage of fingerling Pacific salmon (Oncorhynchus spp.) and steelhead trout (Salmo gairdneri) from the gatewell into an adjoining trash sluice. The orifice positions tested with natural light were: (1) center of gatewell, 1.5-m depth; (2) corner of gatewell, 1.5-m depth; (3) center of gatewell, 4.6-m depth; and (4) corner of gatewell, 4.6-m depth. Hatchery-reared coho salmon (O. kisutch) placed in the gatewell and wild chinook salmon (O. tshawytscha) and steelhead trout that migrated downstream and entered the gatewell were used to evaluate response to different placements. The most effective location was in the corner of the gatewell at a depth of 1.5 meters. Changes from natural to artificial lighting did not improve passage. A darkened gatewell with artificial light over the orifice did affect passage efficiency, however, and should receive careful attention in any future application of a gatewell bypass system. (Auth.)

13555. Hutchinson, Brendan P. (Dept. of Nat. Resources, N. Y. State Coll. of Agric., Cornell Univ., Ithaca, New York). 1971. THE EFFECT OF FISH PREDATION ON THE ZOOPLANKTON OF TEN ADIRONDACK LAKES, WITH PARTICULAR REFERENCE TO THE ALEWIFE, Alosa pseudoharengus. Trans. Amer. Fish. Soc., 100(2): 325-335.

Stomach contents of alewives collected in Black Pond in 1958 consisted primarily of Diaptomus, Epischura, Mesocyclops, and Daphnia. Food of Black Pond alewives in 1966 consisted mainly of Bosmina, Holopedium, cyclopoid copepods (Cyclops, Macrocyclops, Tropocyclops), and chironomid pupae. Alewife stomach contents were compared with limnetic plankton samples to determine whether the alewives were selective in their choice of food organisms. Both species and size selectivity were observed. The evidence collected suggests that alewife predation was responsible for a change in the zooplankton community of Black Pond. The zooplankton communities of 10 Adirondack lakes were compared. The species and size composition of these communities appeared to be influenced by the presence of planktivorous fish. (Auth.)

13556. Cala, Plutarco (Dept. of Animal Ecology, Univ. of Lund, Lund, Sweden). 1970. ON THE ECOLOGY OF THE IDE Idus idus (L.) IN THE RIVER KÄVLINGEÅN, SOUTH SWEDEN. Institute of Freshwater Research, Drottningholm, Report No. 50, pp. 45-99, illus.

13557. Nahhas, Fuad M., and Edwin C. Powell (Dept. of Biol. Sci., Univ. of the Pacific, Stockton, California). 1971. DIGENETIC TREMATODES OF MARINE FISHES FROM THE FLORIDIAN NORTHERN GULF OF MEXICO. Tulane Stud. Zool. and Botany, 17(1): 1-9, illus.

Seventy-three fishes representing 50 species from the Northern Gulf of Mexico in Florida were examined for digenetic trematodes. Thirty-two species harbored 27 Digenea. Two new species are described: the hemiurid Ectenurus yamagutii from Caranx crysos, C. hippos, and Lagodon rhomboides, and the lepocreadiid Lepocreadium sogandaresi from Eupomacentrus leucostictus. Monascus filiformis (Rudolphi, 1819) Looss, 1907 (Fellodistomatidae), known previously from the Mediterranean and reported for the first time from North American waters, is described and figured. (Authors)

13558. Reynolds, James B., and Percy W. Laarman (Great Lakes Fish. Lab., U. S. Fish and Wildlife Serv., Ann Arbor, Michigan). 1970. ESTIMATION OF TOTAL MERCURY IN LAKE ST. CLAIR WALLEYES. Mich. Dept. of Natural Resources, Research and Development Report No. 220, 19 p.

This paper examines the question of sample size required for analyses of mercury in Lake St. Clair walleyes. A sample of 25-30 walleyes, in the size range studied [18.4 to 23.2 inches total length (average 20.3 inches); 2 lb., 1 oz. to 4 lb., 1 oz. in weight (average 2 lb., 11 oz.)] will yield a mean value of mercury content which will be within ± 0.5 ppm of the true mean; about a 5 percent chance exists of the true mean being outside of the sample limits. It is possible that the cost of analyses could be somewhat reduced without loss in precision by compositing all filets and taking fewer subsamples from the composite. However, since no data are yet available on this procedure, it is recommended that the analyses be made on individual fish.

13559. Aass, Per (Ministry of Agric., Vollebekk, Norway). 1970. THE WINTER MIGRATIONS OF CHAR, Salvelinus alpinus L., IN THE HYDROELECTRIC RESERVOIRS TUNHOVDFJORD AND PÅLSBUFJORD, NORWAY. Inst. of Freshwater Research, Drottningholm Report No. 50, pp. 5-44.

During the years 1951 and 1954-68, in all 21,073 char were tagged in the two lake reservoirs and the connecting river. Of these 10,475 were tagged in winter, 1,884 in spring and summer and 8,714 in autumn as spawners. Post-spawning and early winter movements were shorebound feeding migrations, mostly covering short distances. Later in winter, char accumulate in great numbers in the currents near the intakes of the drainage tunnels and in narrow sounds which come into existence with the lowering of the reservoir. The movements are nearly always downstream. Char from neighbouring areas enter the currents first, the populations of distant regions chiefly arriving in middle and late winter. There is a close connection between water level and dispersion of char. When a current attains a certain threshold velocity the char interrupt their migration and keep to the current for the rest of the winter. The catch in the currents consists mostly of fish in the pelagic stage, that is mature or older immature char. It is not proved to what extent the younger fish take part in the migrations. The downstream migrations involve a great part of the total population. Of the more distant spawning populations in Tunhovdfjord, more than 50 percent take part. A fish may participate in several subsequent years. The food supply in the currents is negligible, and the downstream movements make little sense as active feeding migrations. The lowering of the water level brings about a movement of the pelagic char towards deeper water and in contact with the flow through the reservoirs. The further migration is possibly a passive downstream displacement. Important winter fishing arises in the currents. In Tunhovdfjord, the annual rate of exploitation varies between 12-25 percent for distant and local spawning populations respectively. On average, 75 percent of the total char catch in Tunhovdfjord is made by angling in the currents. The corresponding figure for Pålsbufjord is 28 percent. The affinity of char to currents may be exploited to improve the fishing. When managing the reservoirs, the distribution of char most favourable to the fishing should be considered. (Auth. summ.)

13560. Lindstrom, T., A. Fagerstrom, and K.-J. Gustafson. 1970. FISHING PRESSURE, GROWTH AND RECRUITMENT IN A SMALL HIGH MOUNTAIN LAKE. Inst. of Freshwater Research, Drottningholm Report No. 50, pp. 100-115.

An experiment was started in a small high mountain lake to investigate whether the recruitment could be reduced to a point where the individual growth would increase spectacularly. Mean size of trout in the sport fishermen's catches has decreased and the number of trout and char above 24 cm in a standard set of gill nets has decreased although the individual growth of trout has increased. From the possible composite effects of both temperature and increased fishing mortality on recruitment of trout, the most promising seems to be a positive correlation between May - June temperatures and recruitment, combined with a reduction of the spawning trout population in 1959 and subsequent years (due to increased fishing mortality) and a consequently reduced recruitment level beginning with year class 1960. Rough population size estimates are presented in the Appendix. (Authors summ.)

13561. Northcote, T. G., and H. Rundberg (Brit. Columbia Fish and Wildlife Branch, Victoria and Inst. of Freshwater Research, Drottningholm). 1970. SPATIAL DISTRIBUTION OF PELAGIC FISHES IN LAMBARFJÄRDEN (MÄLAREN, SWEDEN) WITH PARTICULAR REFERENCE TO INTERACTION BETWEEN Coregonus albula AND Osmerus eperlanus. Institute of Freshwater Research, Drottningholm, Report No. 50, pp. 133-167.

13562. Luquet, P. (Station centrale de Nutrition, Centre national de Recherches zootechniques, 78 - Jouy-en-Josas, France). 1970. STUDY OF THE DIFFERENT NITROGENOUS COMPONENTS OF SALMONIDAE: PROTEINS, NON-PROTEIN NITROGEN, NUCLEIC ACIDS, VARIATION FACTORS. Ann. Hydrobiol., 1(2): 111-132. (In French with English summ.).

In the present bibliographical review is presented the main work dealing with the nitrogen composition of various Salmonidae. The effect has been shown of numerous factors on the raw protein content (N x 6.25) and on the distribution of proteic nitrogen, principally in the muscle. A special chapter deals with nucleic acid content and its composition. In particular, this review brings to light the major effect of the sexual cycle, especially in migrating salmon. (Auth. summ.)

13563. Atlantic Salmon Association (1255 University St., Rm. 705, Montreal 110, P. Q., Canada). 1971. CANADA'S NEW ATLANTIC SALMON POLICY. Atlantic Salmon Journal, Fredericton, N. B., Canada, No. 1, p. 3.

The Atlantic Salmon Association has endeavoured at all times to interpret 'Conservation' as applying to the well-being of the salmon fisheries as a whole rather than what brings advantage either to the angler or to the commercial netman. To restore the resource to its full potential is a first requirement whether for the rods or the nets. The distribution of inshore and offshore nets, operating along the routes of salmon migration, impede the free movement of salmon from the sea to the rivers. For many years the A.S.A. has urged the gradual elimination of these barriers to reduce the impact on the spawning stocks. Our Resolution 11 passed at the 1966 annual meeting advocated the abolition of driftnets within the territorial waters of all salmon-producing countries. Welcome indeed is the new policy of the Federal Department of Fisheries on changes and controls of the salmon commercial fishery. The following conditions will apply throughout the Atlantic Region: (1) No new commercial fishing licences will be issued to individual fishermen; (2) Existing licences will be non-transferable (This means that, when a commercial fisherman retires from the fishery he automatically retires his licence); (3) A commercial salmon fisherman must fish his gear every year in order to retain his licence; (4) Beginning next year (i.e. beginning in the spring of 1972) individuals who are regularly employed in an industry other than fishing will lose their commercial salmon fishing privilege; (5) Licence Appeal Committees will be set up in each region to review individual cases where extenuating circumstances exist.

13564. Cimino, Michael C., and R. Jack Schultz (Biol. Sci. Group, Ecology, Univ. of Conn., Storrs, Connecticut). 1970. PRODUCTION OF A DIPLOID MALE OFFSPRING BY A GYNOGENETIC TRIPLOID FISH OF THE GENUS Poeciliopsis. Copeia, No. 4, pp. 760-763.

13565. Hansen, Martin J., and Thomas M. Stauffer (Mich. Dept. of Nat. Res., Marquette Fish. Res. Sta., Marquette, Michigan). 1971. COMPARATIVE RECOVERY TO THE CREEL, MOVEMENT AND GROWTH OF RAINBOW TROUT STOCKED IN THE GREAT LAKES. Trans. Amer. Fish. Soc., 100(2): 336-349.

Stocking of hatchery-reared rainbow trout (Salmo gairdneri) in the Great Lakes may be a valuable management practice because the survivors, when caught by anglers, are relatively large fish. In this study we planted 132,973 tagged rainbow trout during 1955-59 at 29 locations along Michigan shores of the Great Lakes and Burt Lake. Three stocks of 2- to 3-year-old trout were used: (1) progeny of Michigan hatchery brood stock, (2) progeny of Great Lakes-run rainbow trout and (3) progeny of sea-run rainbow (steelhead) trout from the State of Washington. Matched plants were used to study four factors that might have influenced recovery rates, namely: (1) month of planting, (2) stock of trout, (3) size of trout, and (4) location of planting (stream versus lake). These, and other plants, also provided information on movement, growth and maturity of rainbow trout in the Great Lakes. The effect of the four factors on angler catch and trout movement and growth was determined by voluntary reports of recoveries by anglers and commercial fishermen. Since our objective was to assess methods of providing relatively large fish for the angler, we used only records on fish which had grown 3 inches or more since planting. These fish added up to 1.2% of the total planted; the rates ranged from 0.0 to 9.3% among the many plantings. For the factors studied, we found: (1) May plantings produced the highest returns, (2) the three stocks did not differ consistently in returns, (3) larger fish gave better returns than smaller fish, and (4) lake planting of the Michigan hatchery stock produced better returns than stream planting. For the plants as a group, the fish ranged widely, and only about 50% of the recovered fish "homed" to the planted stream. In the Great Lakes, planted trout grew from an average total length of 8.8 inches to 16.4 in one growing season, and to 21.4 in two growing seasons. Most trout were recovered in spawning streams during spring and autumn, and within 2 years of the planting date. (Authors)

13566. Campbell, K. Perry (Dept. of Biol., Pa. State Univ., University Park, Pennsylvania). 1971. INFLUENCE OF LIGHT AND DARK PERIODS ON SPATIAL DISTRIBUTION AND ACTIVITY OF THE WHITE SUCKER, Catostomus commersoni. Trans. Amer. Fish. Soc., 100(2): 353-355.

Captive white suckers tend to clump during daylight but are randomly dispersed and more active at night. Increased activity at night may be associated with night feeding. In the present study, white suckers fed mostly at night. Whether or not the nightly increase in activity is indeed associated with night feeding can probably only be determined by measuring the gut contents of suckers captured at different times.

13567. Fast, Arlo W. (Dept. of Fish. and Wildl., Mich. State Univ., East Lansing, Michigan). 1971. EFFECTS OF ARTIFICIAL DESTRATIFICATION ON ZOOPLANKTON DEPTH DISTRIBUTION. Trans. Amer. Fish. Soc., 100(2): 355-358.

The data presented clearly indicate that zooplankton can be limited to shallow depths by hypolimnion stagnation and thermal stratification. When this condition is eliminated, they will distribute to the bottom. They may concentrate near the bottom during the day except in the immediate vicinity of upwelled water. Their greater depth distribution over most of the lake should enchance their survival by making them less conspicuous to sight-feeding fishes. The opposite situation exists in the vicinity of the upwelled water. Not only does this water contain much greater zooplankton concentrations than elsewhere at the lake's surface, but planktivorous fish are attracted to this water.

13568. Reed, Roger J. (Mass. Coop. Fish. Unit, Univ. of Mass., Amherst, Massachusetts). 1971. UNDERWATER OBSERVATIONS OF THE POPULATION DENSITY AND BEHAVIOR OF PUMPKINSEED, Lepomis gibbosus (Linnaeus) IN CRANBERRY POND, MASSACHUSETTS. Trans. Amer. Fish. Soc., 100(2): 350-353.

**13569.** Reed, Roger J., and James A. McCann (Mass. Coop. Fish. Unit, Univ. of Mass., Amherst, Massachusetts). 1971. TOTAL LENGTH-WEIGHT RELATIONSHIPS AND CONDITION FACTORS FOR THE ARCTIC GRAYLING, Thymallus arcticus (Pallas), IN ALASKA. Trans. Amer. Fish. Soc., 100(2): 358-359.

Length-weight relationships and condition factors have been determined for the Arctic grayling, Thymallus arcticus (Pallas), in Alaska. The regression coefficients for the length-weight relationship of male and female grayling were found to be significantly different at the 5% probability level. The majority of fish studied, regardless of sex, exhibited an increase in condition with age. The following conversion factors were computed: TL = 6.22 mm + 1.052 FL, and FL = 5.04 mm + 0.95 TL. These values were derived from 1,283 specimens (size range 146-517 mm TL).

**13570.** Laarman, Percy W. (Inst. for Fish. Res., Mich. Dept. of Nat. Resources, Museums Annex, Ann Arbor, Michigan). 1971. SEASONAL VARIATION IN PROTEIN CONTENT OF BLUEGILL PITUITARY GLANDS. Trans. Amer. Fish. Soc., 100(2): 360-362.

Three distinct periods are evident in the percent protein content of the bluegill pituitary gland. March, April and May collections represent period one; June and July, period two; and August, September and October, period three. During the first period, in early spring, the protein content is about 25%. This has increased to about 38% in the second period and by the first of August to about 56%.

**13571.** Alt, Kenneth T. (Alaska Dept. of Fish and Game, Div. of Sport Fish, Fairbanks, Alaska). 1971. OCCURRENCE OF HYBRIDS BETWEEN INCONNU, Stenodus leucichthys nelma (Pallas), AND HUMPBACK WHITEFISH, Coregonus pidschian (Linnaeus) IN CHATANIKA RIVER, ALASKA. Trans. Amer. Fish. Soc., 100(2): 362-365.

Six inconnu (sheefish) X humpback whitefish hybrids were taken in late September, 1968 at a weir across the upper Chatanika River on the Elliott Highway near Fairbanks. The hybrids have fairly deep bodies like humpback whitefish with an inconnu-like head. Meristic counts and morphometric measurements are presented.

**13572.** Walters, Carl J. (Inst. of Animal Resource Ecology, Univ. of Brit. Columbia, Vancouver, Brit. Columbia, Canada). 1971. MANIPULATION OF FISH POPULATIONS WITH RESPECT TO FOOD PRODUCTION: A CAUTIONARY NOTE. Trans. Amer. Fish. Soc., 100(2): 365-366.

A simple conceptual framework for the long-term relationships among average fish population size (biomass), consumption of food organisms, net production, and yield is presented. The implication of this "model" is that the biologist must carefully define "best" stocking rates and "best" fish population sizes with respect to food resources.

**13573.** Bortone, Stephen A. (Dept. of Biol. Sci., Florida State Univ., Tallahassee, Florida). 1971. PUGHEADEDNESS IN THE VERMILION SNAPPER, Rhomboplites aurorubens, IN THE NORTHERN GULF OF MEXICO. Trans. Amer. Fish. Soc., 100(2): 366-368.

Two pugheaded specimens of Rhomboplites aurorubens (Cuvier) were taken by the author on hook-and-line in the Gulf of Mexico, 25 miles SSE of Pensacola, Florida, on 29 June 1969 in 58 meters of water. These specimens represent the first report of pugheadedness in the family Lutjanidae and in the species R. aurorubens.

**13574.** Eaton, Stephen W., and Lesley Jan Moffett. 1971. A PRELIMINARY STUDY OF CANANDAIGUA LAKE IN 1970. Science Studies, St. Bonaventure Univ., St. Bonaventure, N. Y., Vol. 27, pp. 69-85.

Bottom and plankton samples were taken at 6 stations in Canandaigua Lake during June, July and August 1970. Temperatures and oxygen were taken and compared with earlier ones. The epilimnion was 1° to 1-1/2° C warmer than in the second decade of the century. Large plankters were reduced in numbers and the small Bosmina greatly increased. Bottom samples were comparable. It is suggested

that the alewife Alosa pseudoharengus (common since 1953) may be changing the zooplankton populations. A history of changes in fish populations is included. (Authors)

13575. Tarzwell, C. M. (National Marine Water Quality Lab., Fed. Water Qual. Admn., Dept. of the Interior, West Kingston, Rhode Island). 1971. BIOASSAYS TO DETERMINE ALLOWABLE WASTE CONCENTRATIONS IN THE AQUATIC ENVIRONMENT. Proc. Roy. Soc. Lond. B., 177(1048): 279-285.

Bioassays have been used for many years and many different types of bioassays have been developed. We need to develop effective and efficient bioassay procedures for all the important groups of organisms for both short-term and long-term studies. These bioassays must be standardized so that the results obtained by different workers are comparable. In some instances, bioassays must further be standardized in order to determine relative toxicity of a group of materials. There is a great need for effective, long-term, flow-through bioassays to determine maximum concentrations of wastes and other materials which are not harmful under conditions of long-term or continuous exposure. Data from such bioassays are essential to determine water-quality requirements as a basis for setting water-quality standards for the protection of the aquatic biota. Approaches to these studies have been suggested which, if carried out, will give data essential for setting standards or methods by which maximum allowable concentrations can be determined. Further, these studies will have certain spin-off value for clarifying the use and value of biological indicators and designating what the so-called indicators really indicate about environmental conditions. Studies carried out for the development of short-term methods for determining long-term effects will furnish information which can be used for determining the cause of pollution kills of aquatic organisms. When properly developed and sufficient data are available, these studies will furnish methods whereby slow deterioration of aquatic environments and biota over long periods of time can be detected in their earlier stages. All of these products and values of the use of bioassays are of direct use and of significance in meeting today's pollution problems. (Auth.)

13576. Anderson, J. M. (Fish. Res. Bd. Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1971. ASSESSMENT OF THE EFFECTS OF POLLUTANTS ON PHYSIOLOGY AND BEHAVIOUR. Proc. Roy. Soc. Lond. B., 177(1048): 307-320.

Many pollutants, even when present in the water in concentrations well below lethal levels, may cause marked changes in the physiology and behaviour of fish. The work reported deals mainly with salmonids. The responses to insecticides are particularly interesting. Of fundamental interest is the suggestion that DDT seems to act by interfering with the normal thermal acclimation mechanism(s), probably within the central nervous system. The results are not without practical significance. Some responses, including those induced by heavy metal ions from mining wastes, may cause long-term ecological changes of consequence. (Auth.)

13577. Bryan, G. W. (The Laboratory, Citadel Hill, Plymouth, England). 1971. THE EFFECTS OF HEAVY METALS (OTHER THAN MERCURY) ON MARINE AND ESTUARINE ORGANISMS. Proc. Roy. Soc. Lond. B., 177(1048): 389-410.

Heavy metals such as copper, zinc and lead are normal constituents of marine and estuarine environments. When additional quantities are introduced from industrial wastes or sewage they enter the biogeochemical cycle and, as a result of being potentially toxic, may interfere with the ecology of a particular environment. In different marine organisms, the behaviour of heavy metals is described in terms of their absorption, storage, excretion and regulation when different concentrations are available in the environment. At higher concentrations, the detrimental effects of heavy metals become apparent and their different toxic effects and factors affecting them are also described. (Auth.)

13578. Ackefors, H. (Inst. of Marine Research, S-453 00 Lysekil, Sweden). 1971. MERCURY POLLUTION IN SWEDEN WITH SPECIAL REFERENCE TO CONDITIONS IN THE WATER HABITAT. Proc. Roy. Soc. Lond. B., 177(1048): 365-387.

The occurrence of mercury in water, air, etc., was observed 30 years ago by a German scientist. During the 1950s and 1960s, great attention was paid to the Hg problem in Japan and Sweden. In Sweden the whole environment was contaminated due to the widespread use of Hg in agriculture and industry. The organic Hg compounds of alkyl-type and aryl-type, which were used for 10 to 20 years as fungicides in agriculture and in the pulp industry, have had serious effects on animals in both terrestrial and aquatic environments. These two types of Hg compounds are now forbidden in Sweden. However, a new type of compound, alkoxyalkyl-type, may now be used as a fungicide in agriculture. Much Hg is discharged into the air and water due to industrial activities, e. g. the chlorine-alkali industry and many other activities such as the burning of waste products containing small amounts of Hg. Although most Hg is inorganic Hg or organic Hg in the form of phenyl-Hg (aryl-type) (discharged as industrial wastes), most of the Hg in fish from lakes and the Baltic in Sweden is present as methyl-Hg (alkyl-type). It has been demonstrated that methylation of Hg takes place due to bacterial and enzymic activity. High Hg contents in the wild fauna, grain-eating birds and their predators, gave the first scientific evidence that the terrestrial environment was contaminated. Since the ban on alkyl-Hg in agriculture was introduced the Hg concentrations in birds living in the terrestrial environment and of food such as eggs, pork, etc., produced on land, have dropped. Unfortunately this is not the case in the aquatic habitat. Although the discharge of Hg to water and air have been restricted in Sweden, the whole environment is so heavily contaminated that it will take a long time for the Hg concentrations to decrease. The most serious Hg problem in Sweden today is the high Hg concentration in fish. Fish from a certain number of lakes and from extensive coastal areas on the Swedish east and west coast are now forbidden for sale in Sweden. In general, water organisms or birds feeding in the water habitat have higher 'natural' contents of Hg than terrestrial wildlife. Pike has been chosen as an indicator organism of Hg contamination. Levels higher than 200 ng Hg/g are considered abnormal. Most of the investigated fishes from freshwater and coastal areas have concentrations in the range of 200 to 1000 ng Hg/g. Fish with more than 1000 ng Hg/g exceed the temporary limit of 1 mg Hg/kg (1000 ng/g) now valid in Sweden. Earlier, FAO/WHO proposed a practical residue limit up to 0.05 mg Hg/kg (50 ng/g) for terrestrial food. The effects of Hg intake in man were first observed in Japan. During the years 1953 to 1960, 111 persons living around Minimata Bay were killed or seriously disabled. They were poisoned by fish and shellfish with elevated Hg concentrations. In Sweden elevated Hg concentrations have been observed in blood corpuscles, blood plasma and hair of people eating very much freshwater fish, but also the people eating saltwater fish. (Auth.)

13579. Kilambi, R. V., J. Noble, and C. E. Hoffman (Arkansas Univ., Dept. of Zool., Fayetteville, Arkansas). 1970. INFLUENCE OF TEMPERATURE AND PHOTOPERIOD ON GROWTH, FOOD CONSUMPTION AND FOOD CONVERSION EFFICIENCY OF CHANNEL CATFISH. Preprint, Proc. of the 24th Ann. Conf., S. E. Assoc. of Game and Fish Comm., 11 p.; Selected Water Resources Abstracts, 4(8): p. 47, 1971.

A total of 275 channel catfish, measuring on the average of 21.4 mm in total length were raised in the laboratory for 120 days under controlled temperatures of 26, 28 and 32 C with 10-hr and 14-hr photoperiods. Data on growth, food consumption, food conversion efficiency, and water quality were collected at 15-day intervals. Analysis of length-weight relationship showed that the experimental conditions had no effect on body shape. The fish under 28C-10L had slow growth in length throughout the study period. Variations in food consumption and food conversion efficiency in 15-day intervals were discussed. Average food consumption and food conversion efficiency for the entire study period were discussed in relation to temperature-photoperiod combination. The fish at 28 and 32 C consumed more food under 10-hr than under 14-hr light conditions. There was a direct relationship between photoperiod and food conversion efficiency for the fish at all the three temperatures. Based on overall evaluation of growth, food consumption, food

conversion efficiency, water quality, and mortalities, it was concluded that the optimum condition for raising channel catfish was at 32 C under a 14-hr photoperiod.

**13580.** Bentley, P. A., and R. B. Livingston (Water Resources Research Center, Mass. Univ., Amherst, Massachusetts). 1970. THE ROLE OF AQUATIC VASCULAR PLANTS IN THE EUTROPHICATION OF SELECTED LAKES IN WESTERN MASSACHUSETTS. Mass. Water Resources Research Center, Publication No. 11, 80 p.; Selected Water Resources Abstracts, 4(8): p. 47, 1971.

The growth and distribution of the aquatic vascular plants in nine lakes in western Massachusetts were examined in the field for two growing seasons. The objective of the study was to relate the growth and distribution of the vegetation to trophic levels in acid and alkaline lakes. Environmental parameters monitored included pH, total alkalinity, Secchi transparency, temperature, dissolved oxygen and conductivity. Nutrient levels were found by analysis of surface lake water and plant shoot tissues for nitrogen and phosphorus. No significant correlations were obtained in these analyses. The distribution of the aquatic vegetation was correlated with total alkalinity and conductivity. Three groups of species were noted, those of waters with an alkalinity greater than 40 ppm $CaCO_3$, those of waters with an alkalinity less than 40 ppm $CaCO_3$, and those occurring regardless of alkalinity. Substrate also exerted a strong influence on plant distribution. No plants were found growing below the thermocline in the lakes sampled. Vegetative growth of the aquatic plants generally followed a standard growth curve. The standing crop was correlated with growth form and depth. Standing crops ranged from 0.3 to 420 $g/m^2$ dry wt. Some difficulty was encountered in correlating plant growth with other parameters of trophic level.

**13581.** Durum, W. H., J. D. Hem, and S. G. Heidel. 1971. RECONNAISSANCE OF SELECTED MINOR ELEMENTS IN SURFACE WATERS OF THE UNITED STATES, OCTOBER 1970. U. S. Dept. of the Interior, Geological Survey Circular No. 643, prepared in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife, 49 p.

A nationwide reconnaissance of selected minor elements in water resources of the 50 States and Puerto Rico was made by the U. S. Geological Survey in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife during autumn, 1970. More than 720 samples obtained during October and November 1970 from rivers and lakes were analyzed for arsenic, cadmium, chromium (hexavalent), cobalt, lead, mercury, and zinc. Seventy-nine percent of the 727 samples examined had arsenic concentration less than 10 µg/l (micrograms per liter) which is the lower limit of detection, 21 percent of the samples had arsenic greater than 10 µg/l, and 2 percent had more than 50 µg/l - the maximum considered safe for drinking water. Cadmium was detected in 42 percent of the samples in concentrations ranging from 1 to 10 µg/l. About 4 percent of the river samples had cadmium in excess of 10 µg/l (the Public Health Service upper limit for drinking water) and these occurred in about one-third of the States. The maximum concentration found was 130 µg/l. Chromium (hexavalent) rarely was detected at levels much above 5 µg/l, and occurred in the range 6 to 50 µg/l in only 11 of more than 700 samples. There were no concentrations in excess of 50 µg/l, the upper limit for hexavalent chromium in drinking water. Cobalt concentrations most commonly were below the detection limit (less than 1 µg/l), but cobalt was found in 37 percent of the samples, commonly in the range from 1 to 5 µg/l. The higher value is about the upper limit of solubility of cobalt in normal river water. Lead was found in about 63 percent of samples in concentrations ranging from 1 to 50 µg/l. In a few waters lead was detected in excess of 50 µg/l, the upper limit for drinking water. Lead occurs widely in the range 6 to 50 µg/l. Dissolved mercury ranged from below the lower limit of detection (0.1 µg/l) to 4.3 µg/l and was found in only 7 percent of the samples. In none did the concentration exceed the proposed Public Health Service upper limit for dissolved mercury in drinking water, which is 5 µg/l. Total mercury was found in excess of 5 µg/l in a few instances. The concentration of zinc in most samples was in the range of 10 to 50 µg/l, but occasionally exceeded 5,000 µg/l, the recommended (not mandatory) upper limit for drinking water. The survey shows, as one would expect, that the heavy metals studied are widely

distributed in low concentrations in water. There is some evidence that the concentration levels are related to man's activities in certain instances. There appears to be no widespread occurrence of these metals in water in amounts exceeding current drinking water standards. However, the initial assessment of these data does indicate potential problems in a few areas. Although firm conclusions regarding natural patterns and pollution anomalies cannot be drawn from the first results of a survey of this kind, similar data collected in the future will show whether trends exist in the overall distribution of these metals in water and whether the observed anomalies persist and should be studied in greater detail. (From authors summ.)

**13582.** Johnson, W. E., and J. R. Vallentyne (Fish.Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. RATIONALE, BACKGROUND, AND DEVELOPMENT OF EXPERIMENTAL LAKE STUDIES IN NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 123-128.

Reasons why experimental lake studies form a useful addition to more conventional laboratory experiments and observational field studies of eutrophication are discussed. The developmental history of the Experimental Lakes Area is given, including reasons for the location and a general description of the area set aside for experimental manipulation. (Authors)

**13583.** Cleugh, T. R., and B. W. Hauser (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. RESULTS OF THE INITIAL SURVEY OF THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 129-137.

A reference list is given to locations, areas, maximum depths, transparencies, total dissolved solids, and conductivities of lakes shown on the insert map of the Experimental Lakes Area in the back of this issue. (Authors)

**13584.** Brunskill, G. J., and D. W. Schindler (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. GEOGRAPHY AND BATHYMETRY OF SELECTED LAKE BASINS, EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 139-155.

The Experimental Lakes Area (ELA) is located at 93°30'-94°00'W and 49°30'-49°45'N at an altitude of 360-380 m above mean sea level. This area is underlain by Precambrian acid granites overlain in some areas by thin glacial drift composed largely of sand and gravel of quartz, plagioclase, and K-feldspar. The area was under glacial ice about 14,000 years B.P. (before present). With the melting of this glacial ice, ELA was situated on the eastern margin of glacial Lake Agassiz. As Lake Agassiz levels receded, the present lake basins were formed. The ELA watersheds now drain into the Winnipeg River, which is in the Hudson Bay drainage system. Mean annual temperatures in the vicinity of ELA are between 0.5 and 2.2 C, and annual precipitation is between 500 and 750 mm. Brunisols were observed over sand deposits in the ELA, but considerable variation in soil types and soil depth were also found. ELA is in a boreal (fire-controlled subclimax forest of jack pine, black spruce, trembling aspen, and white birch. Aquatic macrophytes were scarce in the littoral zone of ELA lakes. Nearby logging operations and hunting and sport fishing have not influenced the immediate watersheds of ELA lakes. Morphometric maps and measurements are given for 16 lakes in ELA. These lakes vary from 2.5 to 33 m in maximum depth, and from 1.7 to 56 ha in lake surface area. Using estimates of precipitation, evaporation, evapotranspiration, drainage areas, and lake morphometry, a preliminary calculation of theoretical water renewal time is given for these lakes. These values range from 2.6 to 38 years. (Authors)

**13585.** Schindler, D. W. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. A HYPOTHESIS TO EXPLAIN DIFFERENCES AND SIMILARITIES AMONG LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 295-301.

A preliminary hypothesis is proposed to explain biological differences between Experimental Lakes Area (ELA) lakes in terms of simple morphometric and meteorological parameters, via their effect on nutrient supplies to the lakes. (Auth.)

13586. Schindler, D. W. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. LIGHT, TEMPERATURE, AND OXYGEN REGIMES OF SELECTED LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 157-169.

Light was measured in several Experimental Lakes Area (ELA) lakes in 1968 and 1969, using a Secchi disc, a standard photometer (cadmium sulfide cell), and a 16-channel spectroradiometer. The results of some checks upon the standard procedure usually used for making subsurface light measurements are presented. Light penetration at several wavelengths and total energy flux at several depths are given for a number of lakes. Oxygen and temperature isopleths, winter rates of oxygen depletion, annual heat budgets, and data on work of the wind are also presented. Vertical extinction coefficients (average of all visible wavelengths) ranged from 0.285 for lake 161 to 1.732 for lake 227, and Secchi disc visibility from 1.2 to 10.1 m. The wavelength of maximum transmittance shifted toward long wavelengths, as expected, when transmission coefficients and Secchi disc visibility decreased. Annual heat budgets ranged from 8400 to 24,200 cal/$cm^2$. From 3700 to 16,000 cal/$cm^2$ of this were summer heat income. Summer and annual heat budgets were larger for larger lakes. Annual and summer heat incomes were related to mean depth, surface area, and volume of the lakes by simple linear regression equations. The work of the wind and its efficiency in distributing summer heat income are discussed. The depth of the thermocline in ELA lakes was set early in the year, and did not change during the summer until well after the lake had reached maximum heat content. The temperature of the epilimnion followed the mean daily air temperature closely during the summer though remaining several degrees higher, probably as the result of radiant heating. It is concluded that wind work calculated by Birge's method (Trans. Wis. Acad. Sci. Arts Lett. 18:341-349, 1916) is of little value, unless corrections for back-radiation and evaporation can be made. Rates of oxygen depletion under ice were compared in several lakes. Values ranged from 15.0 to 73.8 mg $O_2/m^3 \cdot$ day and from 36 to 253 mg $O_2/m^2 \cdot$ day. (Auth.)

13587. Armstrong, F. A. J., and D. W. Schindler (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. PRELIMINARY CHEMICAL CHARACTERIZATION OF WATERS IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 171-187.

Water analyses in 1968 and 1969 from 40 small lakes within a small area of the Canadian Shield in northwestern Ontario gave mean values for Ca, Na, Mg, and K of 1.6, 0.9, 0.9, and 0.4 mg/liter with Ca > Na > Mg > K on a molar basis. $HCO_2$, $SO_4$, and Cl (on a smaller number of samples) were 4.1, 3.0, and 1.4 mg/liter. Total $CO_2$ was variable in the range 0.3-12.0 mg/liter. Specific conductance was in the range 10-35 μmho/cm at 35 C and pH 5.4-7.5. Color was < 5-150 Hazen units, and plant pigments (as chlorophyll a) < 1-21 μg/liter. Total dissolved nitrogen was in the range 110-300 mg N/liter and total dissolved phosphorus 3-20 μg P/liter. $NO_3$-N and $PO_4$-P were often undetectable in summer, and reached winter maxima around 100 and 10 μg/liter. Total dissolved nitrogen and phosphorus contents of five lakes were computed at the beginning and end of periods of several weeks during summer stagnation. Changes were negligibly small in three of the deeper lakes, but the two shallowest showed increases of 0.22 and 0.62 g N/$m^2$ and 0.03 and 0.13 g P/$m^2$. Analyses of precipitation and stream waters were used, with stream flow rates, to calculate input and output of nutrients from four of these lakes during the same periods. Retention of nutrients had occurred in all, and it was concluded that in the two deeper lakes nutrients had been lost to the sediments, whereas in the two shallower ones the increases in dissolved nutrients found were derived from the sediments. Analyses of 33 other Canadian Shield lake areas and of 13 other dilute lakes in other regions are tabulated. Comparison with the Experimental Lakes Area (ELA) lakes shows that the latter are more dilute than any in the Shield area except for some in the Northwest Territories, and much more dilute than any others in the world except for some alpine lakes in California. (Authors)

**13588.** Schindler, D. W., and S. K. Holmgren (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. PRIMARY PRODUCTION AND PHYTOPLANKTON IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO, AND OTHER LOW-CARBONATE WATERS, AND A LIQUID SCINTILLATION METHOD FOR DETERMINING $^{14}C$ ACTIVITY IN PHOTOSYNTHESIS. J. Fish. Res. Bd. Canada, 28(2): 189-201.

A modified $^{14}C$ method is described for measuring phytoplankton production in low-carbonate waters. The procedure includes the use of the Arthur and Rigler (Limnol. Oceanogr. 12: 121-124, 1967) technique for determining filtration error, liquid scintillation counting for determining the radioactivity of membrane filters and stock $^{14}C$ solutions, and gas chromatography for measuring total $CO_2$. Primary production, chlorophyll $\alpha$, and total $CO_2$ were measured for two dates in midsummer from each of several lakes in the Experimental Lakes Area (ELA), ranging from 1 to 1000 ha in area and from 2 to 117 m in maximum depth. Phytoplankton species abundance and biomass were determined for the same dates. Production ranged from 0.02 to 2.12 $gC/m^3 \cdot day$ and from 0.179 to 1.103 $gC/m^2 \cdot day$. Chlorophyll ranged from 0.4 to 44 $mg/m^3$ and from 5 to 98 $mg/m^2$ in the euphotic zone. The corresponding ranges for live phytoplankton biomass were 120-5400 $mg/m^3$ and 2100-13,400 $mg/m^2$. Chrysophyceae dominated the phytoplankton of most of the lakes. A system for classifying the lakes in terms of phytoplankton species composition and production-depth curves is developed. (Authors)

**13589.** Sakamoto, Mitsuru (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. CHEMICAL FACTORS INVOLVED IN THE CONTROL OF PHYTOPLANKTON PRODUCTION IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 203-213.

In short-term experiments (6 hr-3 days) the general order of decreasing importance of nutrients added individually to samples of lake water and contained phytoplankton was inorganic carbon, Fe, P, and N. The comparable order for long-term experiments (8-20 days) was P, Fe, N; or P, N, Fe. No relation was found between concentrations of chlorophyll and inorganic carbon in the lakes. The addition of iron and trace elements in chelated form and chelators (HEDTA, NTA) alone, increased photosynthetic carbon intake. The deficiency of iron was mostly due to a lack of iron in a readily assimilable form. (Auth.)

**13590.** Stockner, John G., and F. A. J. Armstrong (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. PERIPHYTON OF THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 215-229.

The periphyton of four Experimental Lakes Area (ELA) lakes was examined in 1969. The littoral zone of all lakes was composed chiefly of large boulders and rock shelfs and the epilithic algal assemblage was accordingly dominant. Depending directly on light penetration and substrate availability benthic algal growth in most lakes was negligible at depths greater than 10 m. Throughout the growing season diatoms were the dominant algal group within the epilithic assemblage, comprising more than 60-70% of the total álgal volume. Filamentous green and blue-green algae increased in importance in July and August but never constituted more than 40% of the volume of the total algal biomass. A well-defined diatom succession was the most abundant diatom encountered in the littoral zone of all lakes. Periphyton growth on glass slides in lake 240 was 27 mg organic matter/$m^2 \cdot$ day during initial colonization and 250 mg organic matter/$m^2 \cdot$ day during the period of maximum growth. The vertical distribution of littoral diatoms in lake 240 was examined and differences among species are discussed in light of possible regulating mechanisms. Achnanthes flexella and Eunotia pectinalis were found only in the psammonal habitat of lake 240. Statistical treatment of chemical analyses of N, P, and chlorophyll $\alpha$ content of periphyton showed no significant difference in amounts of total N among periphyton from lakes, but the distribution of both total P and chlorophyll $\alpha$ was significantly different among lakes examined. Highest concentrations of both P and chlorophyll $\alpha$ were found in lakes 239 and 227. In lake 227, a lake receiving weekly additions of N and P, concentrations of P were significantly greater than in the other lakes. Concentrations of N and P/unit organic weight of periphyton taken at a depth of 1 m in each

of the study lakes were greatest in lake 227. Comparisons among lakes are made and, based on the results of these comparisons, the role of N and P as regulators of periphyton growth in the ELA lakes is discussed. (Authors)

13591. Patalas, Kazimierz (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. CRUSTACEAN PLANKTON COMMUNITIES IN FORTY-FIVE LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 231-244.

Zooplankton communities were characterized on the basis of samples taken in summer as vertical net hauls in the central part of lakes. Twenty-eight species of crustaceans were found in the 45 lakes studied. The highest number of species as well as the highest numbers of individuals (per unit of area) usually occurred in the largest deepest lakes with most transparent water. The most common species were: Bosmina longirostris, Tropocyclops prasinus mexicanus, Mesocyclops edax, Diaptomus minutus, Holopedium gibberum, and Cyclops bicuspidatus thomasi. Daphnids were rather scarcely represented. Senecella calanoides, Limnocalanus macrurus, and Diaptomus sicilis were confined to rather deeper lakes, whereas Diaptomus oregonensis were found mostly in smaller shallower lakes and Diaptomus leptopus in very small, but relatively deep lakes. Diaptomus minutus and C. b. thomasi, though widely distributed, showed a preference for deeper lakes, whereas T. p. mexicanus tended towards smaller shallower lakes. In particular lakes, the number of dominants ranged between 1 and 5, but three dominants per lake was the most commonly encountered case. The simplest community was composed of one cyclopoid, though the most common consisted of one cyclopoid, one diaptomid, and one cladoceran. Four types of communities were distinguished, each of them characteristic for a group of lakes of specific size and depth: (I) in the largest and deepest lakes (389-1007 ha of area, 30-117 m maximum depth); (II) in lakes of medium size and depth (6.5-200 ha, 4.8-33 m); (III) in small and very shallow lakes (3.1-28 ha, 2.7-7.3 m): (IV) in very small lakes with medium depth (1.3-3.7 ha, 6.1-12.8 m). The high degree of similarity between the plankton communities of the Experimental Lakes Area (ELA) and southern Ontario, as well as of some Great Lakes, suggest that they all basically belong to the same zoogeographical area. The fact that most species were distributed evenly throughout ELA may indicate the relative uniformity of the area. In ELA, lake morphology is mainly responsible for defining the type of community. (Auth.)

13592. Schindler, D. W., and Bengt Noven (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. VERTICAL DISTRIBUTION AND SEASONAL ABUNDANCE OF ZOOPLANKTON IN TWO SHALLOW LAKES OF THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd., Canada, 28(2): 245-256.

Seasonal variations in the abundance of zooplankton were studied in lakes 122 and 132 for a period of 10 months beginning in mid-May 1968. Seasonal dynamics of various species are discussed in relation to their patterns in the Canadian Shield and in other localities. Day and night vertical distributions for each lake were sampled on two dates in summer. Three species of rotifers migrated diurnally in lake 122, but no evidence of diurnal movement was found in lake 132. All crustaceans studied in both lakes migrated vertically to some degree, except for nauplius larvae and Leptodora kindtii. There was little difference in vertical distribution patterns on the two dates studied. Average zooplankton biomass in the two lakes was calculated and compared with that found in other studies. Average zooplankton biomass during the ice-free season was 72 and 156 mg/$m^3$ dry weight for lakes 122 and 132, respectively. Dominant species in both lakes were Diaptomus minutus, Cyclops bicuspidatus thomasi, Holopedium gibberum, and Bosmina longirostris. Ecological tolerances for rotifer species agreed well with those found for Swedish waters. (Authors)

13593. Alley, Wayne P., Daniel S. Fertig, and Alex W. Klishevich (Calif. State College, Los Angeles, California). 1971. NEW LOCALITY RECORD FOR THE PUPFISH Cyprinodon nevadensis AT BADWATER, DEATH VALLEY, CALIFORNIA. Calif. Fish Game, 57(2): 128 pp.

A single specimen was collected on July 24, 1970. Water temperature was 30C.

13594. Hamilton, Andrew L. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, 19, Manitoba, Canada). 1971. ZOOBENTHOS OF FIFTEEN LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 257-263.

The composition of the profundal and sublittoral zoobenthos of 15 lakes in northwestern Ontario was closely related to morphometric features of the individual lakes. The amphipod Pontoporeia affinis Lind., and the sphaeriid Pisidium conventus Clessin, were the dominant species in the larger deeper lakes whereas species of Chironomidae and Chaoborinae were the dominant forms in all lakes with mean depths of less than 10 m. Dissolved oxygen concentration and temperature of the bottom water, two characteristics that are largely a function of lake morphometry, are probably the primary factors limiting the distribution of individual species. (Auth.)

13595. Stockner, J. G. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1971. PRELIMINARY CHARACTERIZATION OF LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO, USING DIATOM OCCURRENCES IN SEDIMENTS. J. Fish. Res. Bd. Canada, 28(2): 265-275.

Diatoms in deepwater surface sediment from 16 Experimental Lakes Area (ELA) lakes of varying size and morphometry were separated for analysis on the basis of their generally understood habitat preference into littoral and planktonic groups. The lakes were ranked in order of increasing relative abundance of littoral diatoms recovered from deepwater surface sediment. A significant correlation was found between the abundance of littoral diatoms in deepwater sediments and the morphometric variables: lake surface area (Ao), and shoreline length to lake volume (L/V), and percent littoral development in each lake. The Centrales was the dominant planktonic group in most of the ELA lakes examined., Species of Cyclotella and Melosira were the dominant diatoms in most ELA lakes. The ratio of the two planktonic groups - Araphidineae and Centrales (A/C) - calculated from sediment counts, agreed closely with the A/C ratio enumerated from 1969 phytoplankton counts in two lakes compared. Based on a lake classification scheme using values of the A/C ratio from sediment diatom counts, the majority of ELA lakes were classed as oligotrophic. Analysis of a 155-cm core from lake 240 showed little change in diatom species composition over the past 3000-4000 years. Centrales was the dominant diatom assemblage at all sediment depths. The dominant diatoms in the sediment of lake 240 and the majority of ELA lakes examined were similar to those dominant in the deepwater sediments of well-studied oligotrophic lakes in other lake districts. On the basis of calculated A/C ratios in surface sediment in several lakes at temperate latitudes, a lake trophic classification is proposed. (Auth.)

13596. Brunskill, G. J., D. Povoledo, B. W. Graham, and M. P. Stainton (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, 19, Manitoba, Canada). 1971. CHEMISTRY OF SURFACE SEDIMENTS OF SIXTEEN LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO. J. Fish. Res. Bd. Canada, 28(2): 277-294.

This paper contains some descriptive chemical data on bedrock, soils and profundal lake sediments of the Experimental Lakes Area (ELA). The acid granodiorite bedrock and the plagioclase-K-feldspar-quartz glacial drift of the region exhibit low rates of chemical weathering. Terrestrial vegetation, soil organic matter, and the fine fraction of the glacial drift are concentrated in the lake sediments. The major minerals of the lake sediments are quartz, plagioclase, K-feldspar, illite, chlorite, kaolinite. Loss on ignition for the lake sediment samples varies from 18 to 62% dry weight, organic carbon from 8 to 34% dry weight, total nitrogen from 0.9 to 3.5% dry weight, and total phosphorus from 0.1 to 0.3% dry weight. These surficial lake sediment samples are 88-96% water, and concentrations of major ions in sediment interstitial water are 1.5-5 times the concentration of major ions in lake water. (Authors)

13597. Emig, John W. (Calif. Dept. Fish and Game, Sacramento, California). 1971. CALIFORNIA INLAND ANGLING SURVEY FOR 1969, WITH CORRECTIONS FOR THE 1964 SURVEY. Calif. Fish Game, 57(2): 99-106.

This is the ninth report on California angling trends based on postal card questionnaires. Questionnaires were sent to 0.6% of the resident license purchasers in 1969. The returned cards amounted to a 0.3% systematic sample. Catch and effort by successful anglers were determined for trout, striped bass, sturgeon, black bass, catfish and panfish. Errors in the 1964 survey were corrected. Catch and effort for trout and panfish increased in 1964, and again in 1969. Catches of other fish declined in 1964, but those of black bass and catfish reached record highs in 1969. Striped bass catches remained low. (Auth.)

13598. Kimura, Makoto, and C. E. Blunt, Jr. (National Marine Fish. Serv., La Jolla, California). 1971. AGE COMPOSITION OF SARDINE LANDINGS ON THE PACIFIC COAST OF THE UNITED STATES AND MEXICO IN 1964-1965. Calif. Fish Game, 57(2): 107-112.

California landings of Pacific sardines, Sardinops caeruleus (Girard), during the 1964-65 season amounted to 5,297 tons. During the interseason, 994 tons were landed. Baja California sardine landings totaled 24,675 tons for this period, almost all of which came from San Sebastian Vizcaino Bay and Bahia de la Magdalena. The age structure of the catch and low landings off California and northern Baja California reflect continued failure of the sardine population in the north to produce good year-classes. (Authors)

13599. Jensen, Paul T., and Jackson Hyde (Calif. Dept. Fish and Game, Sacramento, California). 1971. SEX RATIOS AND SURVIVAL ESTIMATES AMONG SALMON POPULATIONS. Calif. Fish Game, 57(2): 90-98.

The effects of sex ratios other than one-to-one on survival estimates produced by Murphy's methods of estimating third-year survival of silver (coho) salmon (Oncorhynchus kisutch) are discussed. Techniques are described for determining sex of fingerling king (chinook) salmon (O. tshawytscha) over 40 mm TL by gross gonad examination. Sex composition of 970 fingerling king salmon at the Coleman National Fish Hatchery was 490 males and 480 females. Evidence is presented which suggests that fish cultural practices may alter the initial sex ratio among propagated silver salmon stocks. (Authors)

13600. St. Amant, James A., and Ira Sharp (Calif. Dept. Fish and Game, Sacramento, California). 1971. ADDITION OF Xiphorphorus variatus (Meek) TO THE CALIFORNIA FAUNA. Calif. Fish Game, 57(2): 128-129.

Variated platys were collected in 1969 and 1970 from the Avenue 82 Drain Ditch, Riverside County California. Jack Wood, owner of a tropical fish farm related that platys had escaped from one of his ponds into the ditch about 1956. (Authors)

13601. Edwards, George D. (U. S. Army, Edgewood Arsenal, Maryland). 1971. SEXUAL DIMORPHISM IN THE PAINTED GREENLING AND OBSERVATION OF DEFENSE OF AN EGG MASS. Calif. Fish Game, 57(2): 129-131.

Reported are observations of Oxylebius pictus Gill made on subtidal reefs off Cannery Row in Monterey Bay, California. (Auth.)

13602. Anonymous. 1968. EUTROPHICATION IN LARGE LAKES AND IMPOUNDMENTS. Uppsala Symposium, Sweden, May 1968; Organization for Economic Co-operation and Development, Paris, 560 p., 1970; Selected Water Resources Abstracts, 4(9): p. 12.

This attractively published 566 pp volume in English and French covers the important aspects of its title. The synopsis of case studies, including lakes Malaren, Lough Neagh, Maggiore, Constance, Laurentian Great Lakes, and Oslo Fjord, presents one of the best 'introductions' to the problem of water eutrophication or pollution that is now facing the world. The section on research and management stresses that in the last analysis the 'eutrophication' or nutrient pollution is but one phase of the problem of water quality, a problem complicated by inert suspensions, poisons, reducing agents, oil, organic matter, hot water, radioactive substances,

and pathogenic organisms. The discussion of current research and future needs provides a comprehensive review of urgent tasks and suggestions for future action. The second part of the volume of about 400 pp comprises detailed reports on the lakes mentioned in case studies and also reports on Morecambe Bay Barrage, Lake Lugano, and impoundments in the Netherlands.

13603. Whitford, W. G. (New Mexico State Univ., University Park, New Mexico). 1970. THE EFFECT OF WATER QUALITY AND ENVIRONMENTAL FACTORS ON FRESHWATER FISH. Available from NTIS as PB-197 676, $3.00 in paper copy; Completion Report, (1970), 6 p., OWRR Project A-003-NMEX (1); Selected Water Resources Abstracts, 4(9): p. 34.

Water temperatures of Rio Grande River ranged from 0C to 29C, pH ranged from 7.4 to 8.6, total hardness varied from 86 ppm in the upper river to 194 .. 6 ppm in the reservoirs. The mean critical thermal maximum (CTM) was 39.9C in fish acclimated in fresh water (10-30 ppm), 28.2C in fish acclimated in water at 85 ppm, 27.3C in fish acclimated at 171 ppm. Ion concentration of 180 ppm and 25 ppm has no effect on the CTM of the mosquitofish, Gambusia affinis. The effect of water hardness on upper lethal temperature of the green sunfish Lepomis cyanellus acclimated at 20C and 30C and hardness levels of 30, 180, and 400 ppm indicated no significant effect of hardness on the incipient lethal temperature 35C for 20C acclimation and 40C for 30C acclimation. The relationship between incipient lethal temperature and acclimation is expressed by the equation, Log (LD50) – 1.322 .. .0056 (CTM in degree C). Incipient lethal of 31C for 10C acclimated fish was obtained. There was no difference in the critical oxygen tension in active fish and nonactive fish. At 20C acclimation the mean oxygen consumption was 0.177 ml/gm/hr.

13604. Ryman, Nils (Inst. of Genetics, Univ. of Stockholm, Box 6801, Stockholm, Sweden). 1970. A GENETIC ANALYSIS OF RECAPTURE FREQUENCIES OF RELEASED YOUNG OF SALMON (Salmo salar L.). Hereditas 65(1): 159-160; Comm. Fish. Abstr., 24(5): p. 10, 1971.

Since almost all salmon released from hatcheries as young smolts are recaptured within the first few years after release, recapture frequency is assumed to be a measure of survival ability. The author derived an equation to express the relation between the coefficient of inbreeding and the expected recapture frequency for any inbred family relative to that for a noninbred family. He suggests that the tendency toward lower recapture frequencies in inbred families (which might be regarded as a lower probability of survival for inbred fishes) could be of importance in the breeding not only of salmon but of other hatchery-reared fish. In a few instances, the relations between families were such that an additive genetic component of variation of recapture frequencies was indicated. Analysis of variance showed a difference between half-sib families that was statistically significant at the 2.5% level. This existence of a genetic component suggests that recapture frequency could be improved by planned genetic selection.

13605. Munns, R. K., and D. C. Holland (Food and Drug Admn, 20th and California Sts., Denver, Colorado). 1971. DETERMINATION OF MERCURY IN FISH BY FLAMELESS ATOMIC ABSORPTION: A COLLABORATIVE STUDY. J. Assoc. of Official Analytical Chemists, 54(1): 202-205; Comm. Fish. Abstr., 24(5): p. 22.

The most sensitive and specific method for the determination of mercury at present appears to be the one based on the measurement of the volatilized mercury vapor by flameless atomic absorption. This method was tested in a collaborative study for the analysis of total mercury in fish. Nine laboratories were involved. The overall mercury recovery in the test samples was 83.5%; the standard deviation was 0.066. The authors recommend that the flameless atomic absorption method for mercury be adopted as official first action.

13606. Sabodash, V. M. (Inst. Hydrobiol., Kiev, USSR). 1970. DYNAMICS OF ZINC CONTENTS IN CARP AT EARLY STAGES OF ITS DEVELOPMENT. Chemical Abstracts, 73(25): 128276u, Dec. 1970; Comm. Fish. Abstr., 24(5): p. 12.

**13607.** Pantelouris, E. M., A. Arnason, and F. W. Tesch (Biol. Dept., Univ. of Strathclyde, Glasgow, C. 1, Scotland). 1970. GENETIC VARIATION IN THE EEL. II. TRANSFERRINS, HAEMOGLOBINS AND ESTERASES IN THE EASTERN NORTH ATLANTIC. POSSIBLE INTERPRETATIONS OF PHENOTYPIC FREQUENCY DIFFERENCES. Genetical Research, 16(3): 277-284; Comm. Fish. Abstr., 24(5): p. 14, 1971.

In a series of studies, the authors are attempting to solve the "Atlantic eel problem," specifically, whether European eels do in fact spawn in the Sargasso Sea and whether they interbreed there with American eels. In the first report of the series (published in 1968), they introduced an improved technique for resolving hemoglobin types by electrophoresis and demonstrated that the eels' esterase patterns vary. In the present report, they compare hemoglobins, serum proteins, and liver esterases of 337 yellow, brown, and silver eels caught in Iceland, Western Scotland, and Germany. The findings confirmed the uniformity in hemoglobin types reported in 1968 -- all 337 specimens showed the four electrophoretic fractions described then. The liver esterases of eels caught in Germany showed significant differences in the frequencies of phenotypes in the fast zone of the electropherogram from those of eels caught in Iceland and Scotland. The frequencies of transferrin phenotypes in eels caught in Iceland and Scotland were significantly different from those caught in France and America. These apparent regional differences in gene frequencies may reflect subdivisions of populations of the European eel; or they may be due to differential selection acting on one population of elvers as it fans out toward the Continent. The implications for the Atlantic eel problem are complex; the authors examine the complexities.

**13608.** Kozik, M., B. Arcimowicz, and J. Dembczynski (Neurologische Klinik, Przybyszewskiego 49, Poznan, Poland). 1970. AN ATTEMPT OF APPLYING LASER RAYS FOR THE DETECTION AND ANALYSIS OF CHEMICAL ELEMENTS IN TISSUE SLICES. Acta Histochemica, 37(1): 203-205 (VEB Gustav Fischer Verlag, 69 Jena, Villengang 2, German Democratic Republic); Comm. Fish. Abstr., 24(5): p. 21, 1971.

Not only do animal tissues contain abundant organic compounds, they also contain numerous inorganic elements. Although methods of detecting proteins, carbohydrates, and lipids in these tissues are well advanced, development of methods for detecting the inorganic elements, which are often present in minute amounts only, seems to be lagging. Available techniques for detecting tissue cations are based either on micro-incineration procedures or on color reactions. Both are troublesome to perform and give unspecific and often highly erroneous results. This report describes a method wherein tissue slices are exposed to the action of a laser ray beam (wavelength $\lambda = [1.6$ nm.], 1 joule of energy) and the spot where the tissue is burned away is analyzed with a spectrograph. The spectrograms reveal bands characteristic of those given by various cations as well as those typical of the organic compounds. The method has two clear-cut merits: it requires a relatively small amount of tissue, for the diameter of the perforation made by the laser ray is only 30 μm; it gives two different, independent, analytical media -- the stable histological preparation with the combustion hole in it, and the spectrogram.

**13609.** Thorpe, Virginia A. (Mich. Dept. of Agric., Lansing, Michigan). 1971. DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION AND FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY. J. Assoc. of Official Analytical Chemists, 54(1): 206-210; Comm. Fish. Abstr., 24(5): p. 23.

This paper describes a simple, rapid method for determining mercury in fish and other food products. The method is an adaptation of the one proposed by J. F. Uthe, F. A. J. Armstrong, and M. P. Stainton [Journal of the Fisheries Research Board of Canada, Freshwater Institute, Winnipeg, Manitoba (1970), to be published] as modified by R. Krueger [Water Resources Commission of the State of Michigan, Lansing, Michigan, unpublished (1970)]. The food samples are wet digested and digestion procedures are described for fish; meat; poultry; eggs, milk, water, blood; and animal feeds. The author obtained good precision on the analyses of replicate

samples on different days by the method, and also obtained adequate recovery of mercury in spiked samples.

**13610.** Hamed, M. G. E., and A. N. Elias (Food Technology Div., National Research Centre, Cairo, Egypt). 1971. EFFECT OF OXYTETRACYCLINE AND CHLORTETRACYCLINE ON SURVIVAL OF THE TREMATODE Heterophyes sp. IN THE FLESH OF MULLET CAUGHT IN BRACKISH EGYPTIAN WATERS. Journal of Food Science, 36(1): 67-69; Comm. Fish. Abstr., 24(5): p. 28.

The mullet, Mugil cephalus, is found in brackish waters of Egypt. It serves as the most common intermediate host for the worms of Heterophyes M. Nasr, J. Egyptian Med. Assoc. 24, 321 (1941) . The authors experimented with the use of oxytetracycline (OTC) and chlortetracycline (CTC) to destroy this parasite in the flesh of the mullet. They dipped whole mullet and portions of the infected mullet tissue in OTC and CTC solutions of different concentrations ranging from 30 to 4,000 p.p.m. The amount of the antibiotics required to destroy the parasites in the flesh of the mullet was far greater than the amount that could be used on the fish for preservation purposes. The authors suggest that further research efforts should be expended in solving this difficult problem.

**13611.** Kashiwagi, Masaaki, and Ryuhei Sato (Dept. of Fish., Fac. of Agric., Tohoku Univ., Sendai, Japan). 1970. STUDIES ON THE OSMOREGULATION OF THE CHUM SALMON, Oncorhynchus keta (Walbaum). III. THE TOLERANCE OF ADULT FISH REARED IN A SALT WATER POND TO FRESH WATER. Tohoku Journal of Agricultural Research, 21(1): 26-31; Comm. Fish. Abstr., 24(5): p. 28.

The purpose of this study was to determine whether adult salmonids which had spent most of their life in sea water could live in fresh water. Chum salmon (25 months old, 22 months of which were spent in a salt-water pond) were transferred abruptly to fresh water. The researchers found that the salt-water reared chum salmon lived a long time after being transferred to fresh water. During the first few days after the fish were transferred to fresh water, the water content of their blood increased and the average value of the freezing point depression of the blood decreased. The water content and average freezing point depression levels of the blood returned to normal levels in about 3 days after the fish had been transferred to fresh water.

**13612.** Cooper, Al (International Pacific Salmon Fish. Comm.). 1971. FRASER SOCKEYE REARING SYSTEM UNDER-UTILIZED. Western Fisheries, 81(4): 38-40; Comm. Fish. Abstr., 24(5): p. 37.

Calculated on the basis of lake area and plankton abundance, the sockeye-rearing capacity of the Fraser River system is 600,300 plankton-acres, of which only 29% is being used by sockeye spawners. If the Fraser system's rearing capacity could be fully realized, the sockeye available to fishermen would be increased by 8,300,000 fish a year. The lack of use can be attributed to the lack of spawning grounds in a number of lakes or to deterioration of the spawning grounds as a result of watershed development. Artificial spawning channels, which require only 1/5 to 1/7 as many spawners as natural channels require to produce an equal run, would open the unused rearing areas and increase existing stocks. Although spawning grounds for pinks, which do not require lake rearing areas, are ample to produce a run two or three times the size of the 1967 run, environmental conditions on some of them may be limiting their effective capacity. Planning and design work on the channel projects are well ahead of available appropriations.

**13613.** Watson, D. G. (Ecosystems Dept., Battelle Memorial Inst., Pacific Northwest Lab., Richland, Washington). 1970. FALL CHINOOK SALMON SPAWNING IN THE COLUMBIA RIVER NEAR HANFORD 1947-1969. AEC Research & Development Report BNWL-1515, UC-48, 46 p.

There was no evident relationship between the operation of the Hanford reactors and the numbers of fish spawning in the Hanford reach of the river. Recent increases in numbers of fall chinook spawners seemed more closely associated with the construction of dams downstream and immediately upstream from Hanford, and the probable displacement of fish from these areas. Water temperatures were less than 15°C during the peak of spawning, well within the upper tolerance limits for this species. (Auth.)

**13614.** Nelson, Norton, Theodore C. Byerly, Albert C. Kolbye, Jr., Leonard T. Kurland, Raymond E. Shapiro, Samuel I. Shibko, William H. Stickel, Jack E. Thompson, Lowell A. Van Den Berg, and Alfred Weissler (Inst. of Environmental Medicine, N. Y. Univ., New York, New York). 1971. HAZARDS OF MERCURY. Special Report to the Secretary's Pesticide Advisory Committee, Dept. of Health, Education, and Welfare, November 1970; Environmental Research , 4(1): 1-69.

The levels of mercury contamination found in freshwater fish in Sweden and Finland are similar to those found in such fish in the United States. On the other hand, fish consumption in this country is regarded as generally somewhat less than in the region of Scandinavia. Medical examinations of heavy eaters of contaminated fish have not revealed conclusive evidence of mercury-related disease in either Sweden or Finland. Nevertheless, the body burdens of mercury of some of those having the heaviest intake of fish in both of those countries were as high as the lower levels reported in persons with methylmercury poisoning in Japan. The major conclusion derived from these and other findings was that it seems unlikely that we will find overt mercury poisoning from the consumption of fish or other food products, as normally marketed, in this country. This is not to say that there may not be a few individuals, who because of high consumption of contaminated fish may have signs of mercury poisoning or suffer possible subclinical effects, including delayed neurologic or intellectual damage. Also, possibly infants or children may have impaired development. As yet, no systematic studies have been undertaken, even in the known areas of human exposure in Sweden and Japan, to identify such subclinical effects. Although we appear to be on safe ground, it is urgent (1) to determine whether subtle health effects are present and (2) to use all possible means to reduce exposure to mercury immediately. The recommendations of the study group are summarized here under the headings: Current regulations; Human exposure; Effects on health; Ecologic effects; Control; Analysis; Distribution and transport; Decontamination; Collaboration and communication; and Other hazards. (Authors summ. of conclusions and recommendations)

**13615.** Anderson, R. Stewart (Canadian Wildl. Serv., Univ. of Calgary Campus, Calgary, Alberta, Canada). 1971. CRUSTACEAN PLANKTON OF 146 ALPINE AND SUBALPINE LAKES AND PONDS IN WESTERN CANADA. J. Fish. Res. Bd. Canada, 28(3): 311-321.

Investigations of crustacean plankton communities in 146 alpine and subalpine waters in some western Canadian national parks and environs showed that species composition varied little from year to year and that there was a mean of 2.93 species per community. Diaptomus arcticus occurred in 60% of the communities. More cladoceran species than copepod species were found, but there were usually more copepod than cladoceran species in a community. Many of the species found in subalpine waters did not occur in alpine waters, where they were probably limited more by physical factors – such as temperature and morphometry – and the presence of large predators than by altitude. Except for anostracans, few species seemed to be restricted to either lakes or ponds in the study area. Congeneric occurrences of large cladocerans or nonpredaceous diaptomid copepods were uncommon, as were co-occurrences of large cladocerans and nonpredaceous diaptomids. (Auth.)

**13616.** Paterson, C. G., and C. H. Fernando (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1971. A COMPARISON OF A SIMPLE CORER AND AN EKMAN GRAB FOR SAMPLING SHALLOW-WATER BENTHOS. J. Fish. Res. Bd. Canada, 28(3): 365-368.

Estimates of the density of freshwater benthic invertebrates in shallow lentic habitats were found to be about 50% higher when samples were taken with a simple corer than when samples were taken with an Ekman grab. The use of the corer also decreased the volume of sediment collected and reduced the tediousness of examining large samples. (Authors)

**13617.** McDowall, R. M. (Fish. Res. Div., New Zealand Mar. Dept., Aro St. Wellington, New Zealand). 1970. THE GALAXIID FISHES OF NEW ZEALAND. Bull. Mus. Comp. Zool. Harv., 139(7): 341-432.

**13618.** Otto, Robert G. (Dept. of Biol., Univ. of Victoria, Victoria, B. C., and Fish. Res. Bd. Canada, Biol. Sta., Nanaimo, Brit. Columbia, Canada). 1971. EFFECTS OF SALINITY ON THE SURVIVAL AND GROWTH OF PRE-SMOLT COHO SALMON (Oncorhynchus kisutch). J. Fish. Res. Bd. Canada, 28(3): 343-349.

Salinity tolerance of juvenile coho salmon (Oncorhynchus kisutch) increased markedly during the period from approximately 1-1/2 months after emergence from the gravel to the onset of the smolt transformation, except for a decline in the fall. In January, salinity tolerance ceased to limit dispersal to the sea. The limiting effects of high salinities on survival were less for larger fish than for smaller individuals and were substantially reduced by a period of exposure to dilute salinities. Growth rate, food intake, and gross food conversion efficiency had the highest values at salinities of 5-10 ppt throughout the pre-smolt period. The results are discussed in relation to the feasibility of using saltwater impoundments as a management tool in increasing coho production. (Auth.)

**13619.** Kerswill, C. J. (Fish. Res. Bd. Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1971. RELATIVE RATES OF UTILIZATION BY COMMERCIAL AND SPORT FISHERIES OF ATLANTIC SALMON (Salmo salar) FROM THE MIRAMICHI RIVER, NEW BRUNSWICK. J. Fish. Res. Bd. Canada, 28(3): 351-363.

Studies of naturally produced Atlantic salmon (Salmo salar) smolts, marked from 1950 to 1961 on tributaries of the Miramichi River by differential finclipping, indicated that commercial fisheries accounted for over 60% of their total utilization as adults. The bulk of commercial recoveries was about equally divided among Newfoundland traps, Miramichi drift nets, and Miramichi trapnets; the remainder came from various commercial catches in the Maritime Provinces and Quebec. The percentages of grilse (1 sea-year fish) in commercial catches were low, 20% for Northwest Miramichi and 17% for Southwest Miramichi fish. Anglers reported 10 and 7%, respectively, of all the recaptures of Northwest and Southwest fish. All these angling recoveries were made in freshwater sections of the Miramichi River. Grilse comprised over 70% of angling recaptures. Spawning escapement accounted for 25% of the Northwest returns, of which 60% were grilse; and 19% of the Southwest returns, of which 85% were grilse. For the total of 174,509 smolts marked on the Northwest Miramichi the minimum survival rate to fisheries and spawning escapement was 2.7%. For 78,117 Southwest smolts, the corresponding value was 2.0%. These survival rates, except for the Newfoundland commercial catches, were not adjusted for completeness of search and other factors. The average ratio of grilse to larger salmon in the adult recoveries, about 0.6:1, was much lower than in more recent smolt-tagging experiments by another worker (about 2:1) and indicated a considerable increase in the ratio for Miramichi stock between 1950 and 1968. (Auth.)

**13620.** Calaprice, J. R. (Fish. Res. Bd. Canada, Biol. Sta., Nanaimo, Brit. Columbia, Canada). 1971. X-RAY SPECTROMETRIC AND MULTIVARIATE ANALYSIS OF SOCKEYE SALMON (Oncorhynchus nerka) FROM DIFFERENT GEOGRAPHIC REGIONS. J. Fish. Res. Bd. Canada, 28(3): 369-377.

The chemical composition of samples of fry and adult sockeye salmon (Oncorhynchus nerka) collected in different areas was characterized by X-ray fluorescence spectrometry. Multivariate analysis of the spectra indicate that fish taken from an area possess recognizably distinct chemical compositions. Discriminant functions computed using spectral data were used to classify unknowns successfully. The relative similarity of groups characterized by fluorescence spectrometry is shown by canonical analysis and the nature of the chemical differences is discussed. The results indicate that these aquatic organisms possess a chemoprint, a form of natural tag. (Auth.)

**13621.** Brett, J. R. (Fish. Res. Bd. Canada, Biol. Sta., Nanaimo, Brit. Columbia, Canada). 1971. SATIATION TIME, APPETITE, AND MAXIMUM FOOD INTAKE OF SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 28(3): 409-415.

Three aspects of feeding relations in sockeye salmon (Oncorhynchus nerka) were studied, using Abernathy pellets. When food was presented in excess at 15C,

mean satiation time was found to be 43 ± 8 min, independent of fish size. Voluntary food intake (appetite) increased with time, approaching a plateau after 25-30 hr deprivation. The greatest increase in appetite occurred between 7 and 11 hr of fasting. The relation between the capacity of the stomach (% body weight) and fish weight (grams) was exponential ($Y = 14.1\text{-}4.95 \log_{10} X$). Five-gram fish consumed 11% dry body weight at one feeding, and 17% on a daily basis. (Auth.)

13622. Gunderson, Donald R. (Wash. State Dept. of Fish., Fish. Center, Univ. of Wash., Seattle, Washington). 1971. REPRODUCTIVE PATTERNS OF PACIFIC OCEAN PERCH (Sebastodes alutus) OFF WASHINGTON AND BRITISH COLUMBIA AND THEIR RELATION TO BATHYMETRIC DISTRIBUTION AND SEASONAL ABUNDANCE. J. Fish. Res. Bd. Canada, 28(3): 417-425.

Females of the ovoviviparous species Sebastodes alutus release their larvae in March in the Washington-British Columbia area. Male maturity data from Queen Charlotte Sound indicated that males probably inseminate females in September or October. Examination of the annual bathymetric cycle in three major commercial trawling areas showed that mating and insemination occur while Pacific ocean perch are moving to deep water from the shallow-water regions inhabited in summer and that females release their larvae while in the deepest part of their bathymetric range. Total 1955 through 1965 catch by month, and 11-year mean monthly catch rates were used to indicate relative seasonal abundance on major fishing grounds. Where deepwater regions were trawled, these indices showed a spring maximum associated with the March spawning period. In all areas studied there was a mid-summer slump in catch and catch rate, and an October maximum occurring during the suggested mating period. (Auth.)

13623. White, E. G. (Tussock Grasslands and Mountain Lands Inst., Lincoln College, Christchurch, New Zealand). 1971. A VERSATILE FORTRAN COMPUTER PROGRAM FOR THE CAPTURE-RECAPTURE STOCHASTIC MODEL OF G. M. JOLLY. J. Fish. Res. Bd. Canada, 28(3): 443-445.

A Fortran program written for an IBM 1130 computer is described for analyses of capture-recapture data using Jolly's 1965 stochastic model. The program versatility permits ready analysis of most forms of data and also provides for selections in the organisation of analyses. (Auth.)

13624. Lenarz, William H., and James H. Green (Fish. Res. Inst. and Div. of Marine Resources, Univ. of Wash., Seattle, Washington). 1971. ELECTRONIC PROCESSING OF ACOUSTICAL DATA FOR FISHERY RESEARCH. J. Fish. Res. Bd. Canada, 28(3): 446-447.

A system for processing acoustical data is described. Acoustical data are recorded on magnetic tape in analog form in the field. The data are converted to digital form and analyzed with the aid of a digital computer. The system provides investigators with considerably more information than is available from paper records now in common use. (Authors)

13625. Broughton, E., and L. P. E. Choquette (Canadian Wildl. Serv., Dept. of Indian Affairs and Northern Development, Ottawa, Ontario, Canada). 1971. SUBCUTANEOUS FIBROMA IN LAKE TROUT (Salvelinus namaycush) IN QUEBEC. J. Fish. Res. Bd. Canada, 28(3): 448-449.

Histological examination of a subcutaneous tumour in each of two lake trout (Salvelinus namaycush (Walbaum) from two lakes in the province of Quebec showed it to be a fibroma. This is the first report of such a neoplasm in lake trout. (Authors)

13626. Savitz, J. (Dept. of Zool., Indiana Univ., Bloomington, Indiana). 1971. NITROGEN EXCRETION AND PROTEIN CONSUMPTION OF THE BLUEGILL SUNFISH (Lepomis macrochirus). J. Fish. Res. Bd. Canada, 28(3): 449-451.

Nitrogen excretion rates increase with an increase in protein consumption levels. A mathematical description of this relation was formulated from the data. Estimates of the effect of specific dynamic action on nitrogen excretion were also calculated. (Auth.)

**13627.** MacCrimmon, Hugh R., Barra L. Gots, and J. Scott Campbell (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1971. WORLD DISTRIBUTION OF BROOK TROUT, Salvelinus fontinalis: FURTHER OBSERVATIONS. J. Fish. Res. Bd. Canada, 28(3): 452-456.

This note supplements the original paper by MacCrimmon and Campbell (J. Fish. Res. Bd. Canada 26: 1699-1725, 1969) by presenting additional information on the native range, attempted introductions, and present world distribution of the brook trout. (Authors)

**13628.** Jensen, A. L. (Environmental Biol. Br., Div. of Environmental Res. and Develop., Tennessee Valley Authority, Muscle Shoals, Alabama). 1971. RESPONSE OF BROOK TROUT (Salvelinus fontinalis) POPULATIONS TO A FISHERY. J. Fish. Res. Bd. Canada, 28(3): 458-460.

From data in the literature, life tables are calculated for seven different brook trout (Salvelinus fontinalis) populations and used to study the mechanisms that reestablish the balance of births and deaths upset by fishing. It appears that a change in age-specific fecundity is the compensatory mechanism in brook trout. (Auth.)

**13629.** Berg, Andre (Biol. Div., EURATOM Joint Research Center, Ispra, Italy). 1970. STUDIES ON THE METABOLISM OF CALCIUM AND STRONTIUM IN FRESHWATER FISH. II. RELATIVE CONTRIBUTION OF DIRECT AND INTESTINAL ABSORPTION IN GROWTH CONDITIONS. Mem. Ist. Ital. Idrobiol., 26: 241-255.

The contribution of direct absorption in the total Ca accumulation of Ca in a growing state is not appreciably lower than the contribution found in a stationary state for the freshwater fish studied. (Auth.)

**13630.** Berg, Andre (Biol. Div., EURATOM Joint Research Center, Ispra, Italy). 1970. STUDIES ON THE METABOLISM OF CALCIUM AND STRONTIUM IN FRESHWATER FISH. III. EFFECT OF EDTA AS A CHELATING AGENT ON THE EXCHANGE OF CALCIUM AND STRONTIUM FROM WATER. Mem. Ist. Ital. Idrobiol., 26: 257-267.

Addition of small amounts of EDTA to water caused noticeable modifications of the Ca and Sr metabolism of the freshwater fish studied. (Auth.)

**13631.** Rogers, Donald E. 1970. A COMPARISON OF THE FOOD OF SOCKEYE SALMON FRY AND THREESPINE STICKLEBACKS IN THE WOOD RIVER LAKES. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries - New series, Vol. 3, pp. 1-43

The food of 1,605 sockeye salmon fry (Oncorhynchus nerka Walbaum) and 3,290 threespine sticklebacks (Gasterosteus aculeatus) in the Wood River lakes, Bristol Bay, Alaska, was analyzed and compared. In the littoral zone of lower Lake Aleknagik, their food consisted largely of midge flies (Tendipedidae) and Entomostraca. Benthos was utilized to a greater degree by the sticklebacks than the fry, and surface insects were utilized to a greater degree by the sockeye fry than the sticklebacks. The proportion of benthos was higher in the food of stream fry. The variation in food composition among sticklebacks was associated with size. In the limnetic zone of the lakes, Entomostraca was the primary food of both species. Winged insects constituted an important part of the diet of sockeye salmon, but they were a minor item in the diet of sticklebacks. The average stomach content of sockeye salmon was about two and one-half times that of sticklebacks of comparable length. The similarity in food composition between the two species was measured by the rank-correlation coefficient. It was greater in the limnetic zone than in the littoral. Interspecific and intraspecific competition for food is discussed. It is probable that in areas of high population density of the combined species, competition for food results in reduced growth of both species. (Auth.)

**13632.** Pella, Jerome J. 1970. DISTRIBUTION AND GROWTH OF SOCKEYE SALMON FRY IN LAKE ALEKNAGIK, ALASKA, DURING THE SUMMER OF 1962. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries - New series, Vol. 3, pp. 45-111.

A study was conducted at Lake Aleknagik, Alaska, during the summer of 1962

to determine the distribution of sockeye fry and their rate of growth with respect to distribution. A beach seine was used to measure the abundance of fry in the littoral zone. An otter trawl was used to measure temporal changes in the abundance of fry in the littoral zone and in the deeper waters immediately adjacent. Echo-sounding equipment and a tow net were used to index the abundance of fry in the limnetic zone. Samples were taken from catches to determine the growth rates of fry with respect to their distribution. Distribution and growth data were analyzed by analysis of variance techniques. During the summer sockeye fry dispersed from the area of highest population density near the major spawning ground toward areas of lesser density. In early summer they remained near shore in shallow water. Midsummer was a transition period, when they occupied deeper water near shore in the day and strayed into the limnetic zone in small numbers at night. In late summer large numbers stayed in the upper 10 to 15 m of the limnetic zone at night, but in the day they remained either in deep water at midlake or near lake bottom in the shelf areas. Sockeye fry in the eastern end of the lake apparently grew more rapidly in early summer than those of the western end, presumably because of early-season crowding of fry near the major spawning bed in the western end. However, later in the season when the fry were more uniformly distributed over the lake, growth rates in the three areas of the lake as measured by tow net samples did not differ significantly. (Auth.)

**13633.** Narver, David W. 1970. IDENTIFICATION OF ADULT SOCKEYE SALMON GROUPS IN THE CHIGNIK RIVER SYSTEM BY LACUSTRINE SCALE MEASUREMENT, TIME OF ENTRY, AND TIME AND LOCATION OF SPAWNING. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries New series, Vol. 3, pp. 113-148.

Spawning populations of sockeye salmon consist of units, each of which spawns in a discrete section of the lake system during a discrete time period. These spawning units form groups, which are recognizable from the lacustrine scale pattern, time of entry, and spawning habits. The goal of the study was to identify the component groups of sockeye spawning in the Chignik River system, Alaska. A consistent and objective method of measuring sample scales from parr and smolt and the nuclear portion of sample scales from adults was developed. Scales from above or below the lateral line, from either side of the fish can be used. Sockeye salmon scales display an anterior oblique orientation to the lateral line in the direction of early development and in the general shape of the scale. The long axis of the focus usually forms an anterior oblique angle with the primary scale axis. Scales above and scales below the lateral line in the same side of the fish tend to be mirror images. The scale measurement technique was based on these characteristics of sockeye salmon scales. The measurement radius was almost perpendicular to the posterior edge of the sculptured field, formed an angle of nearly 17.5 degrees with the primary scale axis, and had the shortest focal radius. Paired t-tests substantiated the validity of the choice of this radius. Circuli were counted and radial distance was measured along this radius on sample scales by several readers and an analysis of variance showed no significant difference in results among experienced scale readers or with time. Interpretation of annuli was validated by following the scale development of each year class. The overlap in characters among scale samples from different groups was so large that it was not possible to assign individuals from mixed samples (taken in the fishery) to spawning groups. Eight major spawning groups were described on the basis of lacustrine scale pattern and age, time of entry, and time and location of spawning. (Auth.)

**13634.** Mackay, N. J. (School of Biol. Sci., Dept. of Zool., Univ. of Sydney, Sydney, Australia). 1971. IDENTIFICATION OF TELEOST GONADOTROPE CELLS USING METHALLIBURE (I. C. I. 33, 828) AND THIOUREA. Experientia, 27(2): 213-215.

The experimental identification of gonadotrope cells of the teleost hypophysis (Plectoplites ambiguus) was possible after treatment with methallibure (I. C. I. 33, 828) and thiourea. (Auth. summ.)

**13635.** Kim, Wan Soo, and Kenneth Roberson. 1970. ON THE USE OF OTOLITHS OF SOCKEYE SALMON FOR AGE DETERMINATION. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries, New Series, Vol. 3, pp. 149-168.

On most scales collected from spawned-out sockeye salmon, the marine growth zones are badly eroded. Otoliths are not absorbed to the extent that their age marks are affected. A method of determining the age of individual spawners from otoliths was developed in this study, and its validity was tested. Sample sagittae and scales were obtained from young salmon taken in the freshwater nursery areas, adult salmon caught in the estuary, and spawned-out dead salmon collected from the spawning grounds. Sagittae were mounted on black plastic concavity plates and were examined under a binocular dissecting microscope under reflected light. The sockeye salmon otolith is comprised of a nucleus and successive growth zones. Under microscopic examination the zones consisting mainly of organic matter appear dark under reflected light, and the zones with a relative abundance of inorganic matter appear white. Under transmitted light, the appearances of these zones are reversed. The terms hyaline and opaque are applied to these two kinds of zones, respectively. The freshwater growth zones of the otolith are termed rings, and the marine growth zones are termed bands. Sagittae of young and adult salmon collected during the months June through September showed the development of an opaque margin in June and a progressive broadening of the margin as the season advanced. Thus, the opaque rings and bands in sockeye salmon otoliths represent this growth period of summer and fall. In age interpretation, therefore, the hyaline rings and bands are counted as annuli (annual zones). The hyaline nucleus is not counted. The reliability of age determination from the saggitta was tested by comparing otolith readings with scale readings for the same fish in a sample taken in the commercial fishery and by comparing otolith reading with freshwater scale reading and length for the same fish in samples taken on the spawning grounds. It was found that the sagitta of the sockeye salmon can be used with confidence as an adequate substitute for sample scales in age studies. (Auth.)

**13636.** Olsen, James C. 1970. PHYSICAL ENVIRONMENT AND EGG DEVELOPMENT IN A MAINLAND BEACH AREA AND AN ISLAND BEACH AREA OF ILIAMNA LAKE. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries, New Series, Vol. 3, pp. 169-197.

The sockeye salmon spawning beaches of Iliamna Lake, Alaska, are of two types, mainland and island. Bottom composition, temperature regime, and source of water circulation in redds of an area of each type were determined. Sand comprised 85 percent of the bottom materials in the mainland beach, whereas coarse gravel and boulders made up 95 percent of bottom materials in the island area. Intergravel water temperatures in the mainland beach area were 1 to 4°C lower than lake temperatures during the period of August 26 to September 10, 1962, but little temperature difference was found in the island area. It seems conclusive that upwelling ground water is the source of water circulation in redds in the mainland beach area, whereas lake currents are the source in the island area. The stages of development in embryos and alevins of sockeye salmon were related to thermal age in incubation experiments in the hatchery at the University of Washington College of Fisheries. Length attained and the first appearance and development of various morphological features were the criteria used to establish stages of development. Fifty percent of the eggs hatched within 643 degree days, and yolk sac absorption terminated at 933 degree days. The rate of development of eggs planted in the study areas was determined with the development series as a guide. Development at the island beach area proceeded at a faster rate than at the mainland beach area because of earlier spawning and a warmer temperature regime. Hatching had commenced at the former by mid-November, but eggs planted at the latter had developed only halfway to hatching by this time. (Auth.)

**13637.** Gilbert, John R. 1970. SURVEYS OF SOCKEYE SALMON SPAWNING POPULATIONS IN THE NUSHAGAK DISTRICT, BRISTOL BAY, ALASKA, 1946-1958. From: Further Studies of Alaska Sockeye Salmon, Univ. of Wash. Publications in Fisheries, New Series, Vol. 3, pp. 199-267.

Methods of enumeration of salmon spawning populations are reviewed with

emphasis on spawning survey techniques. The methods used to survey sockeye salmon spawning grounds in the Nushagak District of Bristol Bay, Alaska, are presented. These surveys sought reliable yearly estimates of the total spawning population in the district and in each of its major spawning areas. Because the data derived and the methods are used extensively in studies in the Nushagak sockeye, they are presented in detail. Results of surveys encompass the years 1946 through 1958. Estimates were obtained primarily by the application of chain-link indices, derived from spawning ground survey data, to initial total population estimates, obtained from comprehensive spawning survey or tower count data for each lake system in the district. The sources and magnitude of error were examined, and the possibility of large errors was recognized. However, the work done by Nelson and Church in 1959-1961, when results could be checked against known population totals, confirmed the practical worth of the survey estimates, particularly those for the years since 1953.

13638. Meekin, Thomas K., and Austin C. Moser. 1971. AN EVALUATION OF THE ROCKY REACH CHINOOK SALMON SPAWNING CHANNEL, 1961-1968. Wash. Dept. of Fish., Technical Report No. 6, pp. 1-28.

The Rocky Reach Spawning Channel was completed in 1961 as a mitigative facility for loss of chinook salmon, Oncorhynchus tshawytscha (Walbaum), spawning grounds resulting from the construction of Rocky Reach Dam on the Columbia River and the subsequent inundation by the reservoir. The 1000-ft long spawning channel was designed to accomodate 330 pairs of chinook. This paper reviews the results of 7 brood years of channel operation from 1961 through 1967. The channel was plagued with severe prespawning mortalities of the female chinook and insufficient numbers of spawners. Survival from egg to migrant averaged 34%, but was inconsistent by season. The relatively few smolts released from the channel were small, averaging 49 mm in length. Adult returns to the channel and upper Columbia River were negligible. In 1968, chinook operations at the channel were terminated. The facility is presently being utilized as an egg incubation and fingerling rearing station for coho salmon, O. kisutch (Walbaum). (Authors)

13639. Mathews, Stephen B., and Thomas K. Meekin. 1971. FECUNDITY OF FALL CHINOOK SALMON FROM THE UPPER COLUMBIA RIVER. Wash. Dept. of Fish., Technical Report No. 6, pp. 29-37.

Fecundity estimates of Columbia River fall chinook were made at the McNary, Priest Rapids, and Rocky Reach channels. The weight sample method, wherein a count is made of about one-third of the egg complement, was shown to give adequate estimates. An analysis of the length-fecundity relationship indicated that there were differences in fecundity from year to year and among the stocks at the different channels. The significance of this is that for a precise estimate of potential or actual egg deposition within a channel during a specific year, a separate sample should be drawn for fecundity estimates. It was shown that a regression estimate of the mean fecundity for a spawning population, using the length-fecundity relationship from the sample and the mean length of the spawned female carcasses, would be approximately 34% more precise than the random sample mean, and should, therefore, be used since the gain in precision is at practically no cost. (Authors summ.)

13640. Magee, John K., and David Heiser. 1971. AN IMPROVED HYDRAULIC EGG AND FRY SAMPLER. Wash. Dept. of Fish., Technical Report No. 6, pp. 38-43.

Past experience with the original design for the venturi unit of the hydraulic egg sampler described by McNeil (1962) revealed severe maintenance problems, particularly with plugging of the annular water passage which mixed the air and water. The Department of Fisheries developed a less costly, more efficient and maintenance-free sampling unit, specifically the venturi or air-water mixing device in the gravel probe. Certain standard plumbing fittings were useful in fabricating a new venturi. The cost of the venturi probe unit is about $25.00 compared to $150.00 to $200.00 for the original venturi. The gravel probing efficiency of the new venturi is about two and one-half times greater than the original design and the amount of maintenance has been negligible. No clogging of the units has been

experienced and the probe has better weight balance. Fry densities were very similar in tests of the old and new venturi units. With the new equipment, accuracy was retained while increased speed of sampling was accomplished. The new venturi is now being used for all hydraulic sampling by the Department of Fisheries. (From authors introduction)

13641. Koehn, Richard K., Julio E. Perez, and Robert B. Merritt (Dept. of Systematics and Ecol., Univ. of Kansas, Lawrence, Kansas). 1971. ESTERASE ENZYME FUNCTION AND GENETICAL STRUCTURE OF POPULATIONS OF THE FRESHWATER FISH, Notropis stramineus. The American Naturalist, 105(941): 51-69.

Electrophoresis on starch gel of muscle homogenates of the freshwater fish, Notropis stramineus, indicated two regions of esterase heterogeneity. The most anodal group (Es-I) consisted of several closely associated minor bands while the more cathodal group (Es-II) exhibited a clear pattern of variation attributable to three codominant alleles segregating at an autosomal locus. A two-allele polymorphism was also detected at a lactate dehydrogenase locus (Ldh). Temperature-dependent activity of the esterase isozymes separated by column chromatography indicated: (1) there is a correlation of Es-I activity at various temperatures with ES-II genotype, and (2) a difference in temperature-dependent activity between the homozygotes and the heterozygote. The Es-I isozymes from Es-II heterozygotes exhibited a maximum activity at temperatures higher than those from Es-II homozygotes. Population samples during 3 years, ranging over more than 300 miles of the Kansas River mainstream, indicated both temporal and spatial stability of the Es-II polymorphism (i.e., no significant variation in p). A regular pattern of heterozygote deficiency was observed among samples when each was compared with expected Hard-Weinberg frequencies. The rather large changes in zygotic frequencies occurring within a single generation suggest a significant amount of differential genetic mortality occurring within populations. (From authors summ.)

13642. Frost, S., A. Huni, and W. E. Kershaw (Dept. of Biol., Univ. of Salford, United Kingdom). 1971. EVALUATION OF A KICKING TECHNIQUE FOR SAMPLING STREAM BOTTOM FAUNA. Can. J. Zool., 49(2): 167-173.

A square-framed, conical net (300-μ pores) was used in the kicking technique described herein for sampling the larger invertebrates of stony streams. Small samples have consistent percentage population components differing significantly from large ones. Even when bottom-dwellers are numerous, less than 20% of those present are collected (including less than 5.4% of the truly lithophilic species). Almost 60% of the fauna collected from any one site is taken at the first kick. Three kicks yield almost 90% of the organisms secured by 10. Some organisms bypass the net or swim from or through it, and if the net is maintained in position for any length of time, stream-drift animals will mask the sample. (Authors)

13643. Umminger, Bruce L. (Dept. of Biol., Yale Univ., New Haven, Connecticut). 1970. EFFECTS OF SUBZÉRO TEMPERATURES AND TRAWLING STRESS ON SERUM OSMOLALITY IN THE WINTER FLOUNDER Pseudopleuronectes americanus. Biol. Bull., 139(3): 574-579.

The average serum osmolality of winter flounder, Pseudopleuronectes americanus, acclimated in the laboratory to -1°C (386 mOsm/liter) was not significantly different from the serum osmolality of fish at 15°C (389 mOsm/liter). Winter flounder survived temperatures as low as -1.5°C in a super-cooled state. When ice crystals were present in the sea water at -1.8°C, the fish froze and died due to nucleation of the supercooled blood. The serum osmolality of freshly caught flounder increased significantly with time after capture (up to six hours) and was significantly higher than the serum osmolality of laboratory acclimated fish at the same temperature. A previous account of "antifreeze" formation in the winter flounder at low temperatures was probably due to an increased serum osmolality produced by trawling stress during capture. (Auth. summ.)

13644. Olson, P. A., R. E. Nakatani, and T. Meekin. 1970. EFFECTS OF THERMAL INCREMENTS ON EGGS AND YOUNG OF COLUMBIA RIVER FALL CHINOOK. Atomic Energy Comm., Res. Devel. Rept. (BNWL-1538), Battelle-Northwest, Richland, Wash., 23 p.

Eggs of fall chinook salmon (Oncorhynchus tshawytscha) were reared for 177 days at different temperature levels in Columbia River water. Four series of spawn, taken at different times during the fall and early winter, were tested. Lots within each series were subject to seven thermal increments at intervals of about 2°F; temperatures in each series varied proportionately in response to normal seasonal changes. Since river temperatures dropped after the start of the initial experiment, later series tolerated greater thermal increments. Temperatures 7.0°F above base river temperatures resulted in excessive mortalities in Series I (spawned Oct. 30) whereas a 12.5°F increment in series IV (spawned Dec. 8) produced a mortality of only 12.4%. Egg mortality was highest at warmest temperatures and most deaths occurred prior to hatching. Fry mortality, under cooler but still adverse temperatures, occurred primarily at commencement of feeding. Increased but favorable temperatures accelerated growth by about 1.4 times for each 2°F increment. Since the margin of safety between ambient and a lethal level widens as river temperatures decrease during the fall, late spawners are ecologically favored over early spawners. (Authors)

13645. Ishii, Kiyoshi, and Kiichiro Yamamoto (Lab. of Freshwater Fish-Culture, Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. SEXUAL DIFFERENCES OF THE LIVER CELLS IN THE GOLDFISH, Carassius auratus L. Bull. Fac. Fish., Hokkaido Univ., 21(3): 161-167. In English.

In sexually mature goldfish, sexual differences were recognized in the structure of the liver cells. The liver cells of mature females were smaller in size and with roundish nucleus in comparison with those of mature males which were similar in structure to those of immature fish of both sexes. Electron microscopically, the female liver cells had much less glycogen deposit and much more developed endoplasmic reticulum in the cytoplasm. Ovariectomy of mature females caused alterations of the liver cells from the type of the female to that of the male. The administration of ethinylestradiol to ovariectomized or to immature fish of both sexes induced a hypertrophy of the nucleus, depletion of glycogen and a prominent increase in amount of endoplasmic reticulum, strongly facilitating the appearance of the cells of the female type in the treated fish. On the contrary, methyltestosterone induced no changes in the liver cells of immature fish. It was confirmed that the sexual differences found in the liver cells of mature goldfish were caused by a certain action of ovarian hormones on the liver cells. (Authors summ.)

13646. Nagahama, Yoshitaka, and Kiichiro Yamamoto (Lab. of Freshwater Fish Cult., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. MORPHOLOGICAL STUDIES ON THE PITUITARY OF THE CHUM SALMON, Oncorhynchus keta. II. CHANGES OF THE PROLACTIN CELLS DURING THE LIFE CYCLE. Bull. Fac. Fish., Hokkaido Univ., 21(3): 169-177. In English.

Cytological changes of the prolactin cells of the pro-adenohypophysis at different stages of the life-cycle of the chum salmon, Oncorhynchus keta, were investigated by light and electron microscopes. During the seaward migration of the salmon fry, the prolactin cells were considerably undeveloped in cytological features when compared with those of the adult fish, though in the specimens caught in the sea the cells seemed to undergo slight changes accompanied by the growth of the fish. The functionally active features of the prolactin cells became recognizable in sexually maturing fish in the coastal sea: the cells were enlarged in size, and were found to contain numerous highly electron dense granules and a well developed rough-surfaced endoplasmic reticulum which was arranged in concentrically organized whorls. Morevoer, their activity became more prominent in the specimens caught at the mouth of the river, and was maintained during the period of the anadromous migration. Accordingly, it is likely that the prolactin cells may play an important role in accomplishing the adaptation of the adult chum salmon to the freshwater condition in the course of anadromous migration.

Moreover, the fact that the cytological active features of the cells have already been recognized before the fish enters into the river suggests the possible occurrence of a certain physiological change preparatory for the coming environmental alterations in the migratory fish. (Authors summ.)

**13647.** Hiroi, Osamu (Lab. of Freshwater Fish-Cult., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. MORPHOLOGICAL CHANGES IN THE CORPUSCLE OF STANNIUS OF THE CHUM SALMON, Oncorhynchus keta, DURING THE MIGRATION AND MATURATION. Bull. Fac. Fish., Hokkaido Univ., 21(3): 179-192. In Japanese with abstract, tables and figures in English.

The corpuscle of Stannius of the chum salmon, Oncorhynchus keta, 78 females and 41 males in total, was examined light- and electron-microscopically. The fish were at various stages in sexual maturity, extending from the time soon after the downstream migration to that after the completion of breeding in the river through the period of feeding migration in the northern Pacific. In 0-year old fish soon after the downstream migration and II-year old fish on the feeding migration in the Bering Sea, the corpuscle was small in size with lobules of irregularly arranged cells, and showed meager accumulation of secretory granules. In the organ, however, glandular cells in every lobule were frequently undergoing mitotic division, indicating the feature of the growth phase of the organ. In IV- to VI-year old fish captured in the northern Pacific in April, probably in a time shortly before their spawning migration, the organ was poor not only of secretory granules in glandular cells but also of the cells in mitosis. Therefore, the corpuscle in this phase may probably be in an inactive, resting plase of secretory function. The corpuscle of maturing fish collected in the Okhotsk Sea in July on the spawning migration showed an obvious increase in size of glandular cells, which displayed a regular palisade-like arrangement along the lobule wall and were provided with expanded cytoplasm rich in granules. Furthermore, glandular cells in the corpuscle of maturing fish captured in the coastal sea or at the river-mouth in September or October on the upstream migration were characterized by the existence of a large number of secretory granules, well-developed rough endoplasmic reticulum and Golgi bodies. These morphological aspects may denote that the accumulation of secretory granules in the cells have progressed gradually during the period of spawning migration from the northern Pacific to the river-mouth. Thereafter, a decrease in size of glandular cells and in number of granules contained in them occurred gradually in the corpuscle of Stannius together with the progress of upstream migration and with approach to full maturation, suggesting the occurrence of a gradual release of secretory material from the cells during this period. It is considered that the corpuscle of Stannius of the chum salmon may accomplish its function in association with physiological changes required for freshwater adaptation of the fish and further with those related to sexual maturation which may possibly accompany the active secretion of sexual steroids from the gonads. (From auth.)

**13648.** Mishima, Seikichi (Res. Inst. of North Pacific Fish., Hokkaido Univ., Hakodate, Japan). 1970. DISTRIBUTION AND MIGRATION OF CHUM SALMON IN THE OKHOTSK SEA, WITH SPECIAL REFERENCE TO IMMATURE FISH. Contr. No. 39 from the Res. Inst. of No. Pacific Fish., Hokkaido Univ.; Bull. Fac. Fish., Hokkaido Univ., 21(3): 210-226. In Japanese with abstract, tables and figures in English.

Both immature and mature chum salmon begin to migrate into the Okhotsk Sea from May with fish of other salmonid species. In the early season, immature chum salmon distribute in the southwestern part of Kamchatska, and then distribute widely along the extent of the Pacific Waters flowing into the Okhotsk Sea through the Kurile Straits. The older fish prevailingly migrate in the early summer migratory season and the younger fish in the late season. In September, immature chum distribute sparsely in the northwestern part of the sea, whereas they distribute densely on the west coast off Kamchatska. It appears that the phenomenon reflects the removal of immature fish from the northern part southwardly as the cooling of surface water occurs. Immature chum salmon consist of four age groups, from 2 to 5 year old fish. No immature fish are found in the 6-yr-old group. The females outnumber the males in the 4- and 5-yr-olds, whereas the males surpass the females in number in the 2- and 3-yr old groups. Immature fish are relatively abundant in water with salinity of

32.60% or higher at the 10 m layer, though this is obscure from August through September. Four-year-old fish are dominant every year. Immature 3- and 4-year-olf fish increase gradually with the lapse of season from the middle of August. The proportion of 3- and 4-year-old immature fish to the total catch seems to have decreased relatively since 1959. This was particularly apparent in 1969. The mean fork length does not differ between immature and mature 2 year-old fish, while it is different in 3- and 4-year-old fish. The immature 3- and 4-year-old fish are always smaller in length than the mature fish. The relationship between the abundance of immature chum in "N" year (X) and that of mature fish in "N + 1" year (Y) is shown as an equation of a regression line, such as; $Y = 0.12X + 0.08$ ($r = 0.73$). (From auth.)

13649. Nakai, Toshio, Takeshi Shibata, and Tsuneyuki Saito (Lab. of Biochem., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. SEASONAL VARIATIONS IN THE METABOLIC ACTIVITIES OF TISSUE CONSTITUENTS OF SOME FISHES - III. ON THE ACTIVITY OF ENERGY-METABOLIZING ENZYMES IN THE MUSCLE AND LIVER OF KOKANEE SALMON. Bull. Fac. Fish., Hokkaido Univ., 21(3): 234-239. In Japanese with abstract and figures in English.

Seasonal variations in the activity levels of some energy-metabolizing enzymes, eleven glycolytic and three concerning the TCA cycle, have been studied in the muscle and liver of Kokanee salmon, Oncorhynchus nerka f. kenerlyi. In June, Bucher's principle of constant proportion groups of glycolytic enzymes was seen to hold for the enzymes including triosephosphate isomerase (TIM), glyceraldehyde 3-phosphate dehydrogenase (GPKH), phosphoglycerate mutase (GPM), phosphoglycerate kinase (PGK) and enolase (EN) found in the muscle and liver. In October and November this principle did not hold for the muscle but did for the liver. From these results it may be considered that in the fish muscle the constant proportion in the activity of glycolytic enzymes is closely related to the physiological conditions of the fish. (Authors)

13650. Nakai, Toshio, Takeshi Shibata, and Tsuneyuki Saito (Lab. of Biochem., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. SEASONAL VARIATIONS IN THE METABOLIC ACTIVITIES OF TISSUE CONSTITUENTS OF SOME FISHES - IV. CHANGES IN THE ACTIVITY LEVELS OF THE MUSCLE GLYCOLYTIC ENZYMES BY SPAWNING OF KOKANEE SALMON. Bull. Fac. Fish., Hokkaido Univ., 21(3): 240-245. In Japanese with abstract and figures in English.

The seasonal variations in the activity levels of seven glycolytic enzymes obtained from the muscle of Kokanee salmon, Oncorhynchus nerka f. keneryli, have been studied over a 10-month period. The fish examined were divided into two groups, one group included the two- or three-year-old spawning fish, and the other the one-year-old non-spawning fish. The activity levels of the enzymes observed showed a slight difference between the two groups during the spawning period (Oct.) e.g., the decreasing rates of the levels were very remarkable, especially those of lactate dehydrogenase (LDH) and glyceraldehyde 3-phosphate dehydrogenase (GPDH), in the spawning group as compared with the non-spawning one. These results are expected to show a slowdown of the metabolic rates of the fish during the spawning period. (Authors)

13651. Nakai, Toshio, Takeshi Shibata, and Tsuneyuki Saito (Lab. of Biochem., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. SEASONAL VARIATIONS IN THE METABOLIC ACTIVITIES OF TISSUE CONSTITUENTS OF SOME FISHES - V. CHANGES IN THE ACTIVITY LEVELS OF SOME ENERGY-METABOLIZING ENZYMES BY SPAWNING OF KOKANEE SALMON, Oncorhynchus nerka f. kenerlyi. Bull. Fac. Fish., Hokkaido Univ., 21(3): 246-251. In Japanese with abstract and figures in English.

Seasonal variations in the activity levels of malate dehydrogenase (MDH), isocitrate dehydrogenase (ICDH), fructose-diphosphatase (FDPase), glutamatepyruvate transaminase (GPT), glutamate-oxaloacetate transaminase (GOT), glucose-6-phosphate dehydrogenase (G6PDH) and creatine kinase (CP) have been studied with groups of one-year-old, two-year-old and three-year-old Kokanee salmon. In the one-year-old, non-spawning group, the activity levels of G6PDH increased

gradually, while those of the other enzymes examined were almost constant. In the two- and three-year-old spawning groups, the activity levels of the enzymes concerning TCA cycle, MDH and ICDH, FDPase, GPT and CP increased during spawning. From these results it might be considered that the energy-obtaining mechanisms of glycolytic metabolism were largely superseded by those of fat metabolism during the spawning duration of Kokanee salmon. (Authors)

**13652.** Deufel, Josef. 1970. CAROFUR, A NEW DRUG FOR CONTROL OF FURUNCULOSIS IN SALMONIDS. (Carofur, ein neues Chemotherapeutikum gegen Furunkulose der Salmoniden). Fischwirt, 20(10): 243-244.

Carofur also known as Nifurprazine is a water soluble nitrofuran. It contains 6.6% of Nifurprazine. In vitro it prevented growth of Aeromonas salmonicida in concentration of $10^{-6}$g per ml. For treatment Carofur was mixed at a rate of 0.1% with feed. It was very effective in control of furunculosis. -- S. F. Snieszko

**13653.** Heuschmann-Brunner, G. 1970. INVESTIGATION ON THE PRESENCE OF AEROMONADS IN BODIES OF DEAD FISHES. (Untersuchungen über die Vermehrung der Aeromonaden im toten Fischkörper). Tierärztliche Wochenschrift, 83 Jahrgang, Heft 19, S. 381-384.

Since bacteria classified as Aeromonas hydrophila, and A. punctata (A. liquefaciens in U. S.) are saprophytic and pathogenic in fishes, studies were made on their development in dead freshwater fishes. Findings reported show that these bacteria multiply rapidly in dead fishes even at a temperature of 2°C in a refrigerator. Therefore detection of these aeromonads in dead fishes has very limited diagnostic significance. Aeromonas salmonicida was not included in these studies. -- S. F. Snieszko

**13654.** O'Hara, James (Biol. Dept. Antioch College, Yellow Springs, Ohio). 1971. RELATIONSHIP OF THE METABOLIC RATE OF EXCISED GILL TISSUE TO BODY SIZE IN TWO SPECIES OF SUNFISH. Canad. J. Zool., 49(3): 373-375.

The respiration rate of excised gill tissue from Lepomis macrochirus and Lepomis gibbosus was lowest in small fish and increased with body size to a stable maximum in larger fish. It is suggested that this relationship is due to size-associated changes in development of intrinsic muscles of the gills which compensates for the reduced surface-to-volume ratio of the gill tissue in larger fish. (Auth.)

**13655.** Lester, R. J. G. (Dept. of Zool., Univ. of Brit. Columbia, Vancouver, Brit. Columbia, Canada). 1971. THE INFLUENCE OF Schistocephalus PLEROCERCOIDS ON THE RESPIRATION OF Gasterosteus AND A POSSIBLE RESULTING EFFECT ON THE BEHAVIOR OF THE FISH. Canad. J. Zool., 49(3): 361-366.

Undisturbed infected fish consumed more oxygen than would uninfected controls of the same weight of fish tissue, the difference presumably being due to the parasite. When the fish were swimming, the extra consumption rose rapidly with an increase in speed, particularly in heavily infected fish. This increased oxygen requirement may account for the spatial distribution of infected fish suggested by field data. (Auth.)

**13656.** U. S. Dept. of Commerce, NOAA, NMFS, Washington, D. C. 1971. LIST OF FISHERY ASSOCIATIONS IN THE UNITED STATES, 1969-70. Dept. of Commerce Fishery Leaflet 634, 11 p.

Sixteen national, 2 international, and 100 local fishery associations in 27 States and the District of Columbia are listed. Each association generally includes the name of one of the officers.

**13657.** Chambolle, Pascal, Roger Cambar, and Daniel Tran. 1970. CHRONOLOGICAL TABLE OF THE EMBRYONIC DEVELOPMENT OF Gambusia sp. (TELEOSTEAN FISH). Table Chronologique du Developpement Embryonnaire de Gambusia sp. (Poisson teleosteen). Bull. Biol. de la France et de la Belgique, 104(4): 443-452.

Excellent plates of the embryonic development of Gambusia sp. are presented.

**13658.** Sarig, S. (Lab. for Res. of Fish Diseases, Nir David, Israel). 1970. INITIAL RESULTS OF SILVER CARP (Hypophthalmichthys molitrix) BREEDING IN ISRAELI FISHPONDS IN 1969. Bamidgeh, 22(4): 95-100.

It is possible to nurse silver carp fingerlings to a stocking size of 10 g and over within 35-50 days in nursery ponds at a density of 30,000-40,000 fingerlings/ha. In these nursery ponds, silver carp obtained a daily total increment of 10 kg/ha, in addition to the yield of about 1000 carps growing with them. Best commercial results in fattening ponds were obtained when 10 - 20 g silver carp fingerlings were stocked at a density of 500-1000 fish/ha. At densities above 1500 fish/ha, the individual growth rate of the silver carp was reduced by at least 50%. The total daily increment per ha at the high density was equal to that obtained at a density of 500 fish/ha, and fish did not reach market size. The high population density of 1500 fish/ha might be suited to intensive nursery stocking in fall for stocking fattening ponds in early spring, or for growing in winter and early spring for marketing in spring and early summer. (Auth. summ.)

**13659.** Yashouv, A. 1970. PROPAGATION OF CHIRONOMID LARVA AS FOOD FOR FISH FRY. Bamidgeh, 22(4): 101-105.

A technique for cultivation of chironomid larvae, utilizing asbestos pans, is described. Larvae were harvested in each pan weekly, and in some cases even more frequently. The density of the thinned chironomid population was estimated in November (i.e., at the end of the growth season) to be 63,700-127,400 larvae/$m^2$. Two hundred and 300 grams of larvae were collected from each pan per week - about 250-375 g/$m^2$. Seasonal variation was found in the numbers of larvae in the pans. The continuous flow of water over the chironomid bed washes away metabolic products of the dense larval population. Periodic thinning of the larvae prevents density dependent factors from slowing growth rate of the larvae.

**13660.** Arcarese, G. (Centro Ittiologico Valli Venete (C.I.V.V.), Via Angeli, 29, 45100 Rovigo., Italy). 1970. PRELIMINARY RESEARCH ON THE ARTIFICIAL PROPAGATION OF Atherina boyeri. Riv. It. Piscic. Ittiopat., 5(2): 27-28.

Atherina boyeri represents a secondary fish crop in Italian brackish-water fish culture. It is considered an important forage-fish for other highly appreciated species such as, sea-bass (Dicentrarchus labrax) and gilt head (Sparus auratus). Consequently, its propagation must be taken into account in the lagoon fishery and in related fish farming. The author briefly describes the first positive results in the artificial egg-fertilization, - incubation and -hatching of such fish in closed-system tanks. The adhesive eggs were fertilized by the dry method and incubated in brackish water (salinity 18%, temperature 20-25°C). They hatched in 220-225 degree-days and were fed for 15 days with complete trout small crumbles. Further research is in progress to improve the method.

**13661.** Arru, E., and F. Ceretto (Istituto di Patologia Generale e Anatomia Patologica Veterinaria, Universita di Sassari, 07100, Sassari, Italy). 1970. PARASITOSIS BY Lernaea cyprinacea IN AQUARIUM FISH Lebistes reticulatus. Riv. It. Piscic. Ittiopat., 5(2): 35-39.

The authors report a severe mortality in aquarium fish Lebistes reticulatus caused by the copepod Lernaea cyprinacea. The parasite's morphology structures, and life cycle are carefully described. The authors suggest opportune prophylactic measures to prevent the introduction of parasitosis in closed environments such as aquariums and fish farms. A careful examination of the carriers, or their prophylactic treatment by medicated baths, is emphasized.

**13662.** Hines, R., and A. Yashouv (Fish Culture Research Station, Dor, Israel). 1970. DIFFERENTIAL LEUKOCYTE COUNTS AND TOTAL LEUKOCYTE AND ERYTHROCYTE COUNTS FOR SOME NORMAL ISRAELI MIRROR CARP. Bamidgeh, 22(4): 106-113.

**13663.** Hoffman, G. L. (Eastern Fish Disease Lab., Bur. of Sport Fish. & Wildl., Kearneysville, West Virginia). 1970. WHIRLING DISEASE OF TROUT AND SALMON CAUSED BY Myxosoma cerebralis IN THE UNITED STATES OF AMERICA. Riv. It. Piscic. Ittiopat., 5(2): 29-31.

Whirling disease is caused by Myxosoma cerebralis (Protozoa: Myxosporida). It is recognized by such external symptoms as whirling, blacktail, misshapen heads, spinal curvature, and by the presence of spores of about 8 to 10 microns in diameter in cartilaginous tissue. Myxosoma cerebralis is probably not indigenous to the United States because it was not recognized in rainbow trout (Salmo gairdneri) or Eastern brook trout (Salvelinus fontinalis) until 1956. Both of these highly vulnerable species have been cultured intensively in the U. S. A. for over 70 years. Whirling disease appeared for the first time in the U. S. A. in 1956 in S. fontinalis at Bellefonte, Pennsylvania. In 1961, whirling disease was reported at Kensington, Connecticut. The contamination probably came through the transfer of live infected rainbow trout. From 1961 to 1968 whirling disease continued to spread throughout northeastern U. S. A. until it encompassed an area about 800 by 800 km (Connecticut south to Virginia and west to Michigan). There is little doubt that it was transferred with live fish shipments, although it is possible that some could have come through frozen trout or contamination of egg shipments. In 1966 whirling disease appeared at a trout farm near Monterey, California, about 3,000 km west of Michigan. Also in 1966, the disease was reported from a fish hatchery at Verdi, Nevada, where symptoms were reported for the first time in S. trutta. In 1969 whirling disease was also reported from a fish hatchery at Gardnerville, Nevada, where rainbow trout and cutthroat trout (Salmo clarki) were affected. Research on whirling disease is complicated by difficulties in establishing experimental infections. Currently, research on whirling disease is also being conducted at: (1) Benner Spring Fish Research Station, Bellefonte, Pennsylvania, (2) Biology Department, Ohio State University, Columbus, Ohio, and (3) Owens-Illinois Co., Castalia Trout Farm, Castalia, Ohio. Drastic measures will have to be taken if the spread of whirling disease in the United States of America is to be halted. Disinfection of earthen ponds is probably not completely effective. If a hatchery water supply is spore-free, changing the earthen ponds to concrete raceways is recommended. The best control for spread of whirling disease is to avoid shipping diseased fish. On July 1, 1968, Title 50-Wildlife and Fisheries, Part 13 - "Importation of Wildlife or Eggs Thereof" was amended to prevent the entry of Viral Hemorrhagic Septicemia (Egtved disease) and further entry of whirling disease into the U. S. A. This federal law states that all imported trout and salmon must be certified as being free of either of these two diseases by a qualified person in the country of origin.

**13664.** Herman, R. L. (U. S. Dept. of the Interior, Bur. of Sport Fish. & Wildl., Eastern Fish Disease Lab., Kearneysville, West Virginia). 1970. LYMPHOSARCOMA OF THE THYMUS OF SALMONIDS. Comparative Leukemia Research 1969. Bibl. haemat. No. 36, p. 646 (Karger, Basel/Munchen/Paris/New York 1970).

The fish thymus is located just posterior and dorsal to the gills. It may stand out as a whitish oblong area but more often it is not readily distinguished. Involution occurs between 2 and 3 years of age in salmonids. Antibodies have been demonstrated in trout thymus so we may assume it has a function similar to higher animals. The lymphoid organs of fish are the anterior kidney and spleen. There are no lymph nodes. Lymphoid tissue occasionally may be found in other organs such as the intestine and liver. Blood cell numbers are extremely variable in fish. Lymphocytes have been reported from 4,000 to 35,000/$mm^3$. Red cells from 1 to 2,000,000/$mm^3$. This variation requires complete standardization of methods for valid results. Dunbar (Nat. Cancer Inst. Monogr. 31, 1969) reported on three brook trout (Salvelinus fontinalis) from the same source which had lymphosarcomas apparently originating in the thymus. Several other fish have been observed at the same hatchery with grossly similar lesions. In addition, four rainbow trout (Salmo gairdneri) from a second hatchery have been observed with identical lesions. Most of the fish have been 3-4 years of age when the lesions were observed. The neoplasia appear to consist of lymphoblasts and to be highly invasive. In sections, blood vessels were filled with tumor cells and only a few red blood cells indicating that the fish were suffering a leukemic state. A single attempt to transmit the condition has been made. Tumor material, blood cells, or serum was injected

into brook trout. After 18 months, no tumors were observed. Electron microscopy examination has not been attempted. (Auth.)

13665. Rabe, F. W., and C. W. Sappington (Dept. of Biol. Sci., Idaho Univ., Moscow, Idaho). 1970. BIOLOGICAL PRODUCTIVITY OF THE COEUR d'ALENE RIVER AS RELATED TO WATER QUALITY, (THE ACUTE TOXICITY OF ZINC TO CUTTHROAT TROUT - Salmo clarki). Water Resource Research Inst., Idaho, Completion Report, Dec. 1970, 16 p.; Selected Water Resources Abstracts, 4(10): p. 32.

Determination of the acute toxicity of zinc to cutthroat trout (Salmo clarki) fingerlings were conducted using two bioassay systems. Methyl orange alkalinity of the test water was 23.9 ppm as calcium carbonate. PH values were near neutrality. In a standard, static bioassay, 24, 48 and 96 hr median tolerance limit (TLm) values of 0.62, 0.27 and 0.09 ppm zinc respectively, were obtained. Results of a recirculating, flowing-water bioassay showed a 24 hr TLm value of 0.42 ppm zinc. No 48 or 96 hr values were found due to statistical non-significance of the data. The inconclusiveness of the results of the running system may be due to changes in the concentration of zinc present in the test water as a result of sorption of the zinc ions to the bottom and sides of the test tank.

13666. Becker, C. D., C. C. Coutant, and E. F. Prentice (Pacific Northwest Laboratories, Richland, Washington). 1971. EXPERIMENTAL DRIFTS OF JUVENILE SALMONIDS THROUGH EFFLUENT DISCHARGES AT HANFORD. PART II. 1969 DRIFTS AND CONCLUSIONS. Atomic Energy Comm. Research & Development Report BNWL-1527, UC-48, 61 p.

Field investigations were conducted from March to September, 1968 and 1969 to determine the effect of heated reactor effluents on juvenile salmonids passing through the central Columbia River. The fundamental approach was to drift groups of fish held in liveboxes through areas representing maximum thermal increments while monitoring exposure temperatures and subsequently comparing survival or mortality among test and control groups. Drifts were conducted either through shoreline retention basins (peculiar to the Hanford site), or through midriver effluent plumes that issued from subsurface point discharges. Mortalities attributed to thermal dose (i.e. intensity and duration of exposure) were generally low. Shoreline drifts resulted in significant mortalities among only a few test groups whereas midriver drifts (primarily through the K reactor plume) resulted in losses only under unfavorable late summer conditions. The relative intensity of thermal dose for any set of river conditions depended largely upon onsite mixing patterns. Shoreline areas were characterized by reduced river flows, relatively low effluent mixing rates and persistence of heated water close inshore. In contrast, plume discharges were characterized by fast river flow, relatively high effluent mixing rates and rapid dispersal of heated water. The most important environmental features regulating thermal dose were river temperatures and river discharges, which ranged from about 2.0 to 20°C and 40,000 to 280,000 cf/sec, respectively, throughout the year. During the migration season, four combinations occurred with increasing potential for thermal damage: low temperature - low discharge (early spring), low temperature - high discharge (late spring), high temperature - high discharge (early summer) and high temperature - low discharge (late summer). The last situation exists from mid-July to August when river temperatures peak near 20°C and discharges drop below 100,000 cf/sec. Most chinook migrants produced in the Hanford area have departed seaward by this time. However, the migration timing of juvenile salmonids from above Hanford is retarded by the reservoir complex until July and August when river conditions are more hazardous. Nevertheless, the disproportionate ratio of effluent volume to total water mass and the rapid decline of plume temperatures after discharge tend to minimize the actual proportion of migrating juveniles that are exposed to sublethal and lethal thermal shock. (Authors)

**13667.** Dominy, C. Leslie. 1971. EVALUATION OF A POOL AND WEIR FISHWAY FOR PASSAGE OF ALEWIVES (Alosa pseudoharengus) AT WHITE ROCK, GASPEREAU RIVER, NOVA SCOTIA. Dept. of Fish. & Forestry Canada, Resource Development Branch, Halifax, N. S., Prog. Rep. 3: 22 p.

A spawning run of 61,000 alewives was used in 1970 to evaluate a pool and weir fishway in Nova Scotia. Fish marked with a new color-coded, paper fastener tag in the tailrace of the adjacent hydroelectric power development took 6-7 days to move into the fishway. The rate of fish movement was faster from pool to pool within the fishway compared to the rate at the entrance. Crowding tests in the fishway pools showed that the exit rate tended to increase in a slightly curvilinear fashion with higher densities of alewives. Fishway capacity was estimated at a peak of 2,000 fish per hour with a daily maximum of 10,000. Analysis of blood lactic acid concentration demonstrated no muscle fatigue as fish passed through the fishway. This blood technique also showed that fish stopped to recover from fatigue in the two larger "rest" pools. The need was identified for more stable water levels in the tailrace at the fishway entrance. In addition, the entrance is better located near an area of relatively quiet water rather than entirely in fast moving, turbulent water. Information is presented on the commercial alewife fishery in the Gaspereau River and on the biological characteristics of the spawning run. (Auth.)

**13668.** Borisov, V. M., and S. I. Doroshev (All-Union Pond Fish. Res. Inst. (VNIIPRKh), Moscow, USSR). 1970. SOME MORPHO-BIOLOGICAL CHARACTERISTICS OF THE EASTERN BREAM (Abramis brama orientalis Berg). Journal of Ichthyology, 10(4): 449-459, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

A study of 678 specimens of bream collected in June-September 1968 in five areas of the Aral Sea showed that many of the morpho-biological characteristics of this species had changed significantly by comparison with specimens collected from 1930-1950. The relative body depth had been reduced and the pattern of its variation with the age of the fish had been disrupted: the relative head length had increased and there was no reciprocal correlation between this character and body length. The condition factor, the rate of increase in weight and length and the length to weight ratio had been sharply reduced. A reduction of fecundity was noted and an increase in the proportion of females in the spawning stock which laid all their eggs in a single spawning. The changes in the morpho-biological characteristics of the Aral bream in the last few years may have been caused by deterioration of the conditions of reproduction following reduction in the flows of rivers and the salinification of spawning grounds, and also by the increased pressure of food competition following the acclimatization in the Aral Sea of Caspian gobies and sand smelts.

**13669.** Shilov, V. I., Yu. K. Khazov, and G. A. Batychkov (Saratov and Volgograd Depts, State Res. Inst. for Lake and River Fish. (GosNIORKh), USSR). 1970. RACES OF VOLGA-CASPIAN STURGEON (Acipenser güldenstädti Brandt). Journal of Ichthyology, 10(4): 460-466, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Back calculations have been made to determine the growth rate of 214 "hiemal", spring-spawning, and "vernal", summer-spawning sturgeon. The data obtained, demonstrates that isolated examples of tagged fish change from the spring-spawning to the summer-spawning population in successive spawnings, justifying the conclusion that there are no genetically segregated races or biological groups in the Volga-Caspian sturgeon. Since summer-spawning fishes generally have a higher growth rate than spring-spawning fish, it is recommended that preference should be accorded to the former in artificial propagation of the sturgeon.

**13670.** Kozlov, V. I. (All-Union Res. Inst. for Sea Fish. and Oceanog. (VNIRO), Moscow, USSR). 1970. A NATURAL HYBRID OF THE SPINY STURGEON [Acipenser nudiventris derjavini (Borzenko)] AND THE KURA SEVRYUGA [A. stellatus (Pallas)]. Journal of Ichthyology, 10(4): 466-471, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

A study has been made of a natural population of a hybrid between the spiny

sturgeon and the sevryuga from the Caspian-Kura basin. A morphological description is given of the hybrid in comparison with the parental species. Mention is made of some biological features of the hybrid: growth rate, spawning migrations, fecundity, age of sexual maturation. The hybrid is distinguished from the initial species not only morphologically, but also by the high growth rate correlated with early sexual maturity, which is a consequence of hybrid vigor.

13671. Druzhinin, A. D. (All-Union Res. Inst. for Sea Fish. and Oceanog., (VNIRO), Moscow, USSR). 1970. MATERIALS ON THE EASTERN REDFIN [Leuciscus brandti (Dyb.)]. Journal of Ichthyology, 10(4): 481-485, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Information is given on the eastern redfin fisheries in Sakhalin waters, and data on size, weight, age, growth rate, the state of the gonads, fat content and food. A small tagging experiment is described.

13672. Ginzburg, Ya. I. (Volgograd Dept., State Res. Inst. for Lake and River Fish. (GosNIORKh) USSR). 1970. REPRODUCTION OF THE LAMPREY [Caspiomyzon wagneri (Kessler)] BELOW THE VOLGOGRAD DAM AND THE DEVELOPMENT OF ITS LARVAE. Journal of Ichthyology, 10(4): 485-493, published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

It is shown that the lamprey is adapted to reproduction below the Volgograd Power Station. A description is given of the spawning period and spawning conditions of the lamprey, and of the biology of the ammocoetes during the river period of existence. An account is given of some observations on the larval morphology of the Volga lamprey.

13673. Badenko, L. V., and L. Ya. Androsyuk (Azov Fish. Res. Inst. (AzNIIRKh), Rostov on Don, USSR). 1970. A PHYSIOLOGICAL AND BIOCHEMICAL DESCRIPTION OF VIMBA AND SHEMAYA BROOD STOCKS MAINTAINED IN LAGOON (LIMAN) TYPE FISH FARMS. Journal of Ichthyology, 10(4): 494-502 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

An account is given of the results of research aimed at clarifying the effect of habitat on the reproductive capacity of the cyprinid fishes vimba (Vimba vimba) and shemaya (Chalcalburnus chalcoides). Determinations were made of hemoglobin content, the number of erythrocytes, the amount of fat, moisture, protein and free amino acids in the muscles, liver and roe of the vimba and the shemaya in different stages of the sexual cycle. It is shown that when maintained in a lagoon type environment the gonads mature in vimba and shemaya brood stocks mainly by the mobilization of endogenous material. The dynamics of fat and protein accumulated in the muscles and roe reflect the intermittent nature of spawning.

13674. Soin, S. G. (Dept. of Ichthyology, Moscow State Univ., Moscow, USSR). 1970. EMBRYONIC AND LARVAL DEVELOPMENT OF THE WHITE SEA FLOUNDER [Pleuronectes flesus bogdanovi (Sandeberg)]. Journal of Ichthyology, 10(4): 503-514 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

The paper is the first account of data on the development of the White Sea flounder. Information is given on the reproductive biology, the steps and stages of embryogeny are described and comparison is made with the development of another White Sea species, the dab (Limanda limanda), on which basis it has been possible to detect morphological differences in their embryos and larvae. Data are cited concerning the adverse effect of reduced salinity on the development of flounders in connection with the abnormal hydrologic regime in the White Sea in 1966. It is established that there is partial development of flounder eggs fertilized by cod milt.

13675. Vukovič, T. (Dept. of Ichthyology, Moscow State Univ., Moscow, USSR). 1970. ANNULUS FORMATION ON THE SCALES OF THE UCHINSK RESERVOIR ROACH. Journal of Ichthyology, 10(4): 515-519 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Annulus formation and increase in the length and weight of the Uchinsk reservoir roach (Rutilus rutilus) are traced in the paper from May through September 1960.

The annulus is formed in May in sexually immature fishes and in June-July in sexually mature fishes. Increase in the length and weight of all age groups is particularly intensive immediately after formation of the annulus.

**13676.** Pinus, G. N. (Central Lab. of Ichthyological and Hydrochemical Res. (TsLIGI), Moscow, USSR). 1970. THE FOOD OF AZOV TYUL'KA LARVAE (Clupeonella d. delicatula) AND THE EFFECT OF FEEDING CONDITIONS ON THE ABUNDANCE OF THE PROGENY. Journal of Ichthyology, 10(4): 519-527 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

A description is given of the food of Azov tyul'ka larvae by areas of the Gulf of Taganrog in the years following regulation of the discharge of the Don. It is established that the mortality of larvae from May through June is dependent on the supply of their food (Copepoda) in May. The abundance of Azov tyul'ka underyearlings is dependent on the number of larvae 10-15 mm found in quantity in June.

**13677.** Sobolev, Yu. A. (Belorussian Fish. Res. Inst., USSR). 1970. FOOD INTERRELATIONSHIPS OF YOUNG GRASS CARP, SILVER CARP AND CARP REARED JOINTLY IN PONDS IN BELORUSSIA. Journal of Ichthyology, 10(4): 528-533 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

The paper sets out the results on the food interrelationships of the young of phytophagous fishes and of the carp when jointly reared in ponds, and also data on selectivity in the feeding of the grass carp before it changes over to the plant food specific to it. Indication is given of the size and age at which the grass carp and the silver carp go over completely to feeding on macrophytes and phytoplankton; stocking densities and feeding rates are given for the fish species reared. Calculations are given of the food requirements and of the existence of natural food in ponds for the stated stocking densities.

**13678.** Erman, Ye. Z. (All-Union Pond Fish. Res. Inst., Rybnoye Subdepartment, Moscow Province, USSR). 1970. INTESTINAL ABSORPTION OF VARIOUS SUGARS IN YEARLING CARP. Journal of Ichthyology, 10(4): 534-537 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

The content of individual monosaccharides was studied by chromatography in the contents of the intestines of yearling carp fed on different concentrates. It was established by the method of inert matter that uronic acids, galactose and glucose are absorbed comparatively rapidly in the fish intestine. Mannose and xylose are more slowly absorbed. Their quantity is perceptibly increased due to hydrolysis of oligosaccharides.

**13679.** Senkevich, N. K., and N. I. Kulikova (Azov-Black Sea Res. Inst. for Sea Fish. and Oceanog. (AzCherNIRO), Kerch, USSR). 1970. INTRASPECIFIC DIFFERENTIATION OF SERUM PROTEINS IN THE BLOOD OF BLACK SEA MULLETS. Journal of Ichthyology, 10(4): 538-544 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

The task of the investigation was a study of intraspecific differentiation of mullet serum proteins to establish its usefulness for investigation of subpopulations of the species. The study was carried out on the striped mullet, the golden gray mullet and the gray mullet. Serum proteins were analyzed by the Grabar and Burton method of electrophoresis on agar gel. Use was made of the following characteristics: the electrophoretic mobility of the protein fractions, their quantity, their distribution on the electrophoregram, and the percentage proportion and frequency of occurrence of the individual protein components.

**13680.** Lapin, V. I., and Ye. G. Chernova (Dept. of Ichthyology, Moscow State Univ., Moscow, USSR). 1970. PROCEDURE FOR LIPID EXTRACTION FROM CRUDE FISH TISSUES. Journal of Ichthyology, 10(4): 563-566 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

13681. Zuyev, G. V., and V. V. Belyayev (Inst. of the Biol. of the Southern Seas, Ukrainian Acad. of Sci., Sevastopol', USSR). 1970. AN EXPERIMENTAL STUDY OF THE SWIMMING OF FISH IN GROUPS AS EXEMPLIFIED BY THE HORSEMACKEREL (Trachurus mediterraneus ponticus Aleev). Journal of Ichthyology, 10(4): 545-549 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Consideration is given to features of the group swimming of the Black Sea horsemackerel in a biohydrodynamic setting. Conclusions concerning the three-dimensional structure of a moving school are drawn on the basis of a study of the kinematics of swimming; individual groupings are established within the school and there is discussion of the possibility that a group hydrodynamic effect may operate to help fishes to swim within the school.

13682. Magomedov, G. M. (Dagestan Dept., Caspian Fish. Res. Inst. (KaspNIRKh), Makhachkala, USSR). 1970. SOME DATA ON THE CHUM SALMON Oncorhynchus keta (Walb.) ACCLIMATIZED IN THE CASPIAN SEA. Journal of Ichthyology, 10(4): 552-555 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

In recent years as a result of regulation of the discharge of the Terek, the construction of the Divichi Power Station project on the Samur River and the Mingechaur Dam on the Kura River, the Caspian "salmon" (Salmo trutta caspius) has been cut off from its natural spawning grounds in the upper reaches of these rivers. Its commercial stocks have declined from 400 thousand kg in 1936 to 10 thousand kg in 1960. It was therefore decided to acclimatize in the Caspian Sea the Far Eastern chum, which is capable of spawning in the lower reaches of rivers. Incubation of the eggs was completed at the Samur Fish Farm in Dagestan, from which 5,850,000 fry of this fish have been released into the sea. The first mature chum migrants were found in 1964 in the Karasu 1 River. The spawning migration of breeding chum into the Karasu 2 River begins in the first half of September and ends at the end of October, i.e., in the new body of water the periods at which the chum ascends the rivers are the same as in its area of origin. The ratio of males and females alters perceptibly during the run. Males arrive first, there are more females during the "mass run" and more males at the end of the run. It is known that a single male chum takes part in spawning several times during the spawning season. Throughout the entire spawning run females were numerically predominant over males and accounted for 63% of all fish. The spawning population of chum in the Almaz River consisted of two age groups (1+ and 2+), whereas in the rivers of Sakhalin and in the Amur the bulk of the chum returned to spawn in the fourth and fifth year of life. Spawning fish 2+ years old predominated in the population; they accounted for 66.6% of all fish. The mean length (fork length) of females at an age of 1+ was 58.5 cm (mean weight 2542 g) and of males correspondingly 53.9 cm and 1852 g. Females at an age of 2+ were 61.6 cm and weighed 3033 g, males were 64 cm and weighed 3165 g. In the second year of life the males were 4.6 cm shorter than the females and 689.6 g lighter. At an age of 3 years, on the other hand, males are 3.6 cm longer than females and heavier by 131.9 g. The absolute fecundity of chum 2+ years old in the Almaz River is 2679 eggs and that of chum 3+ years old is 2739 eggs. The chum has found exceedingly favorable conditions for growth and development in the Caspian, as is shown by the rapid return, the high growth rates and the fecundity. In terms of these characteristics it is considerably superior to the chum inhabiting the Far East.

13683. Kogan, A. V. (Volgograd Dept., State Res. Inst. for Lake and River Fish., USSR). 1970. AGE-RELATED AND SEASONAL CHANGES IN THE DAILY FEEDING RHYTHM OF THE TSIMLYANSK RESERVOIR BREAM. Journal of Ichthyology, 10(4): 557-561 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Consideration is given to age-related, seasonal and local changes in the daily feeding rhythm of the bream, Abramis brama. Age-related changes of this rhythm are manifested in reduction in the amount of time spent by fishes in feeding in the course of the day as they grow. Changes are to be noted in the feeding rhythm and the duration of feeding in the course of the day in relation to season: the longer are the hours of daylight, the more protracted is the feeding of the bream. The feeding period of the fishes is shorter in deep than in shallow water. More of the preferred food items are found in the food bolus of the fishes in hours of intensive feeding.

**13684.** Rudakovskiy, L. G., L. N. Solodilov, V. R. Protasov, V. M. Krumin', A. G. Poddubnyy and N. A. Gordeyev (All-Union Res. Inst. for Geophysical Prospecting Methods, USSR). 1970. THE FRIGHTENING OF FISH BY AN EXPLOSION. Journal of Ichthyology, 10(4): 555-557 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

Study of the effect of weak explosion impulses on the fish fauna is of great interest for the development of methods of controlling fish behavior. For example, it would be possible by using the repellant effect to work out a scheme for the carrying out of seismic prospecting in bodies of water detonating small warning charges before the main detonation. Fright is also a promising approach for the development of new systems of fishing and preventing the death of fishes in a zone of hydraulic engineering works. The authors of the present paper, while studying means of frightening fishes, carried out experimental studies to verify the effect of an explosion on fishes for control of their behavior. The energy sources employed were pneumatic emitters with chamber volumes of 0.7 and 3 liters and a gas detonator with a chamber volume of 8 liters, whose main energy was concentrated in the frequency band 20-150 cps, and also the detonation of hexogen charges weighing between 1.5 and 35 g. Observations were made of the behavior of the bream, the blue bream (Abramis ballerus) the pike and the roach in natural areas fenced off from surface to bottom by gill nets. The catch of tagged fishes justifies the assumption that the emitters employed had a frightening effect on the blue bream. The bream did not react to the chosen stimulus in the experiments. The fact that more untagged roach and pike were caught on the inside than on the outside of the net also indicates that these fishes may possibly have been frightened by the explosive effect.

**13685.** Kuz'mina, V. V. (Inst. of the Biol. of Inland Waters, USSR Academy of Sciences, Borok, Yaroslavl Province, USSR). 1970. THE OCCURRENCE OF A LONG-LIVED BURBOT WITH A BASOV'S GASTRIC FISTULA. Journal of Ichthyology, 10(4): 561-562 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

The application of a Basov's fistula to the stomach of fishes is the most convenient and readily effective method of obtaining gastric juice under the conditions of a chronic experiment. The use of antibiotics, the carrying out of the operation under sterile conditions and modification of some of the details of operative technique have made it possible to increase the survival period of fishes after the operation. Thus, burbots with a Basov's gastric fistula applied under septic conditions perished typically within a month of the operation and only 9.1% survived more than one month; the maximum survival period was 37 days. The survival period of burbots operated under aseptic conditions was considerably longer. Of the operated fishes 68% survived for more than 1 month. Most of them died within 6 months of the operation. One of the 25 fishes in the second group survived for more than 2 years and 7 months (926 days) after the operation. During this time the burbot was fed once a week with live Crucian carp weighing 26-30 g, of which it was able to take 5-6 at a time without apparent harm to itself. The burbot is apparently one of the most successful subjects for research since the lack of scales eliminates the need to create an "operational field" which becomes a "gateway for infection" when devoid of scales and rapidly undergoes necrosis. It is also apparently of significance that the burbot is a relatively inactive bottom-dwelling fish capable of living for a long time in a small volume of water.

**13686.** Sharipov, K. O. (Dagestan Dept., Caspian Fish. Res. Inst. (KaspNIRKh), USSR). 1970. ANTIGENIC FEATURES OF THE CASPIAN SALMON AND OF THE BROWN TROUT OF THE TEREK AND SULAK RIVERS. Journal of Ichthyology, 10(4): 571-572 published by Amer. Fish. Soc. in cooperation with Scripta Publishing Corp.

It was possible to establish in the complement fixation test that the Terek Salmon is most closely related to the Terek brown trout in the antigenic composition of the serum and tissues. However, the Terek and Sulak brown trout differ considerably in their antigenic omposition from the Kura salmon.

13687. Grant, Blake F., Paul M. Mehrle, and Thomas R. Russell (Fish Pesticide Res. Lab., Bur of Sport Fish. & Wildl., Columbia, Missouri). 1970. SERUM CHARACTERISTICS OF SPAWNING PADDLEFISH (Polyodon spathula). Comp. Biochem. Physiol., 37(3): 321-330.

Parallel estimates of thirteen serum parameters were made in four female and eight male paddlefish taken at spawning. Sexual "dimorphism" was found in serum non-protein nitrogen, cholesterol, and cortisol. Although paddlefish appeared to regulate the major electrolytes, Na, K and Cl, similar to other freshwater teleosts, both sexes had lower serum Ca, NPN, protein and glucose concentrations. Low serum Ca levels in paddlefish suggest physiological hypocalcemia and, in this respect, paddlefish show phylogenetic affinity to the other chondrostei, the sturgeons. (Authors)

13688. Schaefer, Richard H. (N. Y. State Conservation Dept., New York). 1970. FEEDING HABITS OF STRIPED BASS FROM THE SURF WATERS OF LONG ISLAND. N. Y. Fish Game J., 17(1): 1-17

The diet of striped bass in the south shore surf of Long Island consisted of both vertebrate and invertebrate organisms whose relative proportions and occurrences as food items fluctuated according to size of fish and season of capture. Relative occurrence of invertebrate foods decreased significantly between spring and fall but exhibited no significant differences according to fish size. Relative occurrence of vertebrate foods increased significantly between spring and fall, as well as with corresponding increases in fish size. Amphipods and mysids were the dominant invertebrate foods encountered, whereas the bay anchovy was the most common vertebrate form. Observed differences between feeding habits and traditional angling methods for striped bass in the surf during the summer are offered as a partial explanation for the generally poor catch rates recorded in that season. (Auth.)

13689. Sudds, Richard H., and Ronald C. Craig (State Univ. College at Plattsburgh, Plattsburgh, New York). 1970. DISTRIBUTION OF LARVAL DIGENETIC TREMATODES IN A PART OF LAKE CHAMPLAIN AND THEIR RELATIONSHIPS WITH FISH AND WILDLIFE. N. Y. Fish Game J., 17(1): 33-44.

During the period from 1961 to 1968, a total of 6, 887 snails were collected from eight different sites in Lake Champlain in the vicinity of Plattsburgh and were isolated individually in lake water according to genus and species. Each snail was examined daily for one week for shed trematode cercariae. The number and name of each type of cercaria observed were recorded for each genus of snail. Ten families of digenetic trematodes were represented. The relationships of each type of trematode with its definitive host are discussed to indicate the importance of these parasites to the health of their fish, bird and mammal hosts. (Authors)

13690. Smirnova, L. I. (Central Inst. of Haematology, Moscow, USSR). 1971. PATHOLOGY OF CARP BLOOD INFESTED BY HAEMOGREGARINA. Hydrobiologia, 37(1): 1-6.

Successive stages of development of Haemogregarina ciprini sp. n. from the blood of the carp are described. The life cycle of Haemogregarina is accomplished in erythrocytes and, apparently, in leucocytes. In order to establish infestation with Haemogregarina, systematic observations of the blood are necessary (2-3 times per month during the summer), in which different stages of the life cycle are discovered. Pathological changes of the blood are noted; expressly, decrease in osmotic resistance of the erythrocytes, their destruction, and in connection with this increase in the number of granulocytes, pathological condition of leucocytes of all categories (lightning effect and vacuolization of their plasma). The indicated blood changes are intensified with emergence of the schizonts. Since in certain seasons a considerable percentage of the erythrocytes is destroyed by Haemogregarina, the ability of the blood to carry out the respiratory function decreases greatly which can be connected with periodic mortality of the fish. -- Robert M. Howland

13691. Turner, Charles H., Earl E. Ebert, and Robert R. Given. 1969. MAN-MADE REEF ECOLOGY. The Resources Agency, Calif. Dept. of Fish and Game, Fish Bull. No. 146, 221 p.

This report discusses in detail findings and observations made during more than 4 years of study on three experimental multi-component man-made reefs, and one "production" model reef, in Santa Monica Bay California (August 1960 - January 1965). The multi-component replication reefs were each constructed of 333 tons of quarry rock, one streetcar, 14 automobile bodies, and 44 concrete shelters. The "production" model reef was 1000 tons of quarry rock. The study was designed to investigate various aspects of man-made reef ecosystems and to determine the optimum material for reef construction in southern California. Observations made and sampling conducted at each reef included: (i) enumeration (by estimate) of the fishes, invertebrates, and plants, (ii) sediment analysis, (iii) water temperature, (iv) water clarity, and (v) encrusting growths on each reef material. Quarry rock was determined to be the preferred reef building material (based upon cost and ease of handling), even though the concrete shelters attracted the largest number of fishes. Further, quarry rock disturbed the bottom sediments less than the other three materials. True succession, not seasonal progression was recorded for the various encrusting organisms. During the first year, a barnacle-hydroid phase was closely followed by mollusk-polychaete, ascidian-sponge, and finally encrusting ectoproct stages. Subsequent stages involve aggregate anemones, gorgonians, and stony corals. More than 200 invertebrates (protozoans to tunicates) were recorded during this study. Notations concerning each species occurrence, growth importance on the reef, ecological niche, and known predator-prey relationships are presented. Fish populations around each reef, and material, were assessed by: (i) species enumeration, (ii) estimates of size ranges, (iii) feeding habits, and (iv) general behavioral traits. Underwater tagging techniques were developed and employed to determine fish movements. In all, 78 species (35 families and 60 genera) were recorded. Embiotocid perches and serranids were dominant during the first two years of reef life. In time they decreased in dominance while resident species (e.g., cottids, gobies, damselfish, etc.) increased. Observed fishes were classified as reef associated or non-reef associated, based upon their requirements or association to our reefs: a reef biotype being required to satisfy one or more life processes of a reef oriented species. We further subdivided the reef associated species into semi-resident (which periodically leave the reef) and resident forms (which consistently remain on the reef). Fishing success on the reefs was two to three times that recorded for nearby natural reef areas. In some instances, due to the fish concentrating effect of these structures, angler success may be even higher. Man-made reefs can turn "non-productive" areas of the nearshore into "productive" fishing areas. Initially, these structures attract fishes from surrounding areas. With time (about 5 years in our area) a natural situation is reached and the plant and animal populations exhibit fluctuations typical of reef ecosystems. (Authors)

13692. Cairns, John, Jr., John S. Crossman, Kenneth L. Dickson, and Edwin E. Herricks (Dept. of Biol. and Center for Environmental Studies, Virginia Polytechnic Inst. and State Univ., Blacksburg, Virginia). 1971. THE EFFECT OF MAJOR INDUSTRIAL SPILLS UPON STREAM ORGANISMS. Preprint for 26th Purdue Industrial Waste Conf., May 4-6, 1971 at Purdue Univ., 18 p. plus tables.

The effects of an abrupt acute stress from an industrial spill of ethyl benzene and creosote was to decrease the diversity and density of both the fish and bottom fauna for a distance of approximately 3 miles below the site of the spill. A differential response to the stress was apparent with all major groups of fish except the minnows being entirely eliminated in the stressed area. Perhaps the minnows avoided the stress by swimming into small isolated tributaries or rapidly reinvaded the area or are more tolerant to this type of stress. Mayflies, stoneflies, caddisflies and mussels could not survive the stress and were eliminated. However, mayflies and stoneflies appear to be rapid reinvaders while the others appear to have more than six months to reinvade. Riffle beetles, trueflies, crayfish, some snails and segmented worms were able to survive the short term exposure of this type stress. (Authors summ.)

13693. Miles, Harry M. (Fish. Res. Inst., College of Fish., Univ. of Washington, Seattle, Washington). 1971. RENAL FUNCTION IN MIGRATING ADULT COHO SALMON. Comp. Biochem. Physiol. 38(4A): 787-826.

Renal function of adult coho salmon, captured in salt water during their spawning migration, was measured both in salt water and fresh water. Urine flow exhibited a tenfold increase from a mean of 0.406 ml/(kg x hr) in salt water to a mean of 4.65 ml/(kg x hr) in fresh water. Glomerular filtration rate increased from a mean of 1.48 ml/(kh x hr) in salt water to a mean of 9.06 ml/(kg x hr) in fresh water. PAH (p-aminohippuric acid) clearance was measured at blood PAH concentration from 0.154 to 14.4 mg/100 ml and was found not to be a good measure of renal plasma flow. Renal plasma flow estimated from the magnesium clearance of a salt water adapted fish was found to be 79.6 ml/(kg x hr). Excretion rates of sodium, potassium, calcium, magnesium, and chloride were measured. The rate of excretion of magnesium changes from a mean of 72.4 μ-equiv/(kg x hr) in salt water to a mean of 14.1 μ-equiv/(kg x hr) in fresh water. Water, sodium, potassium and chloride are reabsorbed from the glomerular filtrate. However, calcium and magnesium are secreted into the glomerular filtrate in fishes both in salt water and fresh water. It is concluded that in salt water, the salmon kidney functions to conserve water while excreting magnesium and in fresh water, functions to excrete water while conserving salts. (Auth.)

13694. Gerald, Jerry W. (Dept. of Zool., The Univ. of Texas, Austin, Texas). 1971. SOUND PRODUCTION DURING COURTSHIP IN SIX SPECIES OF SUNFISH (CENTRARCHIDAE). Evolution, 25(1): 75-87.

Sounds were recorded in colonies of six species of sunfish (Lepomis megalotis, L. humilis, L. punctatus, L. macrochirus, L. cyanellus and L. microlophus) under natural conditions. No sounds were heard in a seventh species (L. auritus) during observations that included 17 courtships and three spawnings. This lack of sound production during courtship may be an important cue for mate recognition in this species. The calls of the sound-producing species consist of a series of grunt-like sounds or popping sounds (in L. microlophus) and were heard during active courtship of a female by a nesting male. The males produced at least part of the sounds because L. megalotis, L. humilis, and L. macrochirus males could be induced to court and call to dead females that were manipulated on a string. Also, the jaws of L. microlophus males could be seen to snap shut as the popping sounds were heard during courtship. The sound producing mechanism in the other species and whether or not the females also produce sounds is not known. Except for the L. microlophus sounds, which may exhibit transients with frequencies up to about 7 KHz, the frequencies used in these calls is under 2 KHz, with the highest amplitudes under 1 KHz. The mean sound duration for each species is about 0.64 seconds except for L. cyanellus which averages 0.36 seconds. The mean pulse repetition rates of L. punctatus, L. megalotis, and L. humilis are different at the 0.01 level. The sounds of L. macrochirus, L. cyanellus, and L. microlophus showed almost no pulsation. L. cyanellus has a much shorter grunt duration than L. macrochirus and L. microlophus and these two differ primarily in the number of sounds per call. L. microlophus produces one or at most two sounds together while L. macrochirus almost always produces a series of grunts. The total number of sounds recorded for each species and the percentage showing pulsation are: L. macrochirus 80 (7%), L. punctatus 200 (25%), L. humilis 199 (66%), L. megalotis 141 (96%), L. cyanellus 24 (0%), and L. microlophus 34 (0%). Preliminary playback experiments of the courtship sounds indicate that L. megalotis, L. humilis and possibly L. macrochirus are attracted to their conspecific calls, at least during spawning. The other species have not been tested yet. (Auth. summ.)

13695. Fagerström, A., K.-J. Gustafson, and T. Lindström. 1969. TAG SHEDDING, GROWTH AND DIFFERENTIAL MORTALITY IN A MARKING EXPERIMENT WITH TROUT AND CHAR. Inst. of Freshwater Research, Drottningholm, Report No. 49, pp. 27-43.

There is good evidence of extensive tag shedding in the two small lakes studied in the Swedish high mountain. Variation with fish length is not indicated by this

material but it might very well exist. The actual degree of shedding is highly dependent on the tagging technique used and the environment in this particular experiment. The shedding of nylon-thread tags probably started somewhere between three months and one year after the tagging. Tags with stainless steel are also shed but not at the same rate. There is a low recapture rate for the fish that were small at tagging and this is evident already the first summer after tagging. It cannot be attributed to selective fishing as far as trout is concerned. From what can be inferred about the procedure of tag shedding, this shedding can hardly be responsible for the low recapture of small fish during the first summer, so this low recapture rate is attributed to gear selectivity, higher natural mortality or divergent behaviour of small fish. The problem concerning the low rate of recapture of small fish is thus largely unsolved, but the harmlessness of the gear catching the fish at tagging is at any rate of little importance compared with the gear selectivity or the effect of tagging on small fish during actual tagging and the time that follows. The growth of tagged fish is retarded and the rate of retardation is estimated. It is inferred that some small trout die soon after tagging while others recover, and that mainly gear selectivity and increased natural mortality remain as explanations for the low recapture of small fish during the first summer. (Authors summ.)

**13696.** Gustafson, Karl-Jakob, Thorolf Lindström, and Ake Fagerström. 1969. DISTRIBUTION OF TROUT AND CHAR WITHIN A SMALL SWEDISH HIGH MOUNTAIN LAKE. Inst. of Freshwater Research, Drottningholm, Report No. 49, pp. 63-75.

The distribution of trout and char in a small high mountain lake is studied. The study concerns the action of different types of gear and the movements of the fish. The degree of habitat segregation, or rather the interspacing of char and trout that is tolerated, constitutes the main contribution from this study. (Authors summ.)

**13697.** Höglund, Lars B., and Jan Härdig (Inst. of Zoophysiology, Univ. of Uppsala, Sweden). 1969. REACTIONS OF YOUNG SALMONIDS TO SUDDEN CHANGES OF pH, CARBON-DIOXIDE TENSION AND OXYGEN CONTENT. Inst. of Freshwater Research, Drottningholm, Report No. 49, pp. 76-119.

Starting with aerated Uppsala tap-water (originally hard, bicarbonate-rich, subsoil water), environmental fluctuations of pH and $pCO_2$ were obtained by the addition of hydrochloric acid to this feed water, which flowed continuously through an alternating-water-quality test apparatus. Two or three isolated specimens of fish were observed simultaneously. Decreasing pH, combined with increasing $CO_2$ tension, provokes changes in locomotor behaviour and ventilation among second-summer parr of the Atlantic salmon (Salmo salar). Extremely adverse $pH/pCO_2$ conditions, in combination with low $O_2$, also give rise to delayed chromatophore reactions. The locomotor reactions, mainly due to $CO_2$, are particularly intense on the introduction of a changed water quality into the test apparatus. The intensity of reaction depends on the time of contact, the combination and the quantity of the external factors varied, i. e. the degree of deviation from the pre-acclimatization water quality, which is the control condition of the tests. Similar reactions but reversed in time and less intense also occur after a test period in conjunction with and after the return once again to control conditions. Pure oxygen depletion - down to a critical value in the range of 1–3 mg $O_2/l$ – provokes hyperventilation but does not initiate any changes in behaviour, e. g. any locomotor activities. Nor does any "initial peak" appear on the ventilation curve, which is characteristic of most of the $pH/pCO_2$ deviation and combination tests performed. Similar experiments, starting with a softer surface water from the River Dalalven confirm that the reactions displayed in Uppsala water are mainly due to $CO_2$. The parr – which under control conditions remain on the whole immobile in resting positions on the bottom of the test chamber — accordingly display characteristic behavioural reactions of the whole organism, but also reactions on the organo-physiological and cell-physiological levels of integration. The intensities of these reactions may be taken as measures of an exogenously released or environmental stress. In the present experiments this was mainly a respiratory distress. In the cases of $pH/pCO_2$ and $pH/pCO_2/O_2$ changes towards lowered pH and $O_2$ content – but to a less extent in the cases of environmental

changes of pH or $O_2$ per se – the respiratory stress is reinforced by a working or loading stress on account of the muscular activity exerted during the emergency reaction which is induced in the fishes' confrontation – without being given any choice – with unpleasant or adverse environmental conditions, as regards the abiotic factors studied. From an ecological and physiological point of view two main principles are discerned which make it possible for the parr to withstand high external carbon-dioxide tensions, viz. (1) avoidance reactions and "comfort for survival" and (2) the regulation of a $CO_2$-induced acidosis to obtain normal pH in the blood by a presumable new acid-base equilibrium during retained $CO_2$ supersaturation in the ambient water. The latter compensatory mechanism is an example of an "internal regulatory homeostasis". In the case of environmental $O_2$ depletion the respiratory stress involves first of all, an immediate reflex response, which is easily recognized from the ventilatory rate but in the second place and only at critically low $O_2$ contents an emergency behaviour is also provoked. It cannot be decided, from the observations made in the present experiments, whether or to what extent the immediate hyperventilation response and the "initial peak" on the ventilatory curve connected with excited locomotor activities due to raised $pCO_2$ in the respiratory water is attributable to external and/or internal stimulation of $CO_2$-sensitive receptors. The consequences of the acidification of fish-producing waters by air and water pollution and the possible additional effects of artificial abiotic factors are emphasized. (Authors)

**13698.** Lawler, G. H. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba, Canada). 1969. OCCURRENCE OF Triaenophorus spp. IN LAKE MÄLAREN FISHES. Inst. of Freshwater Research, Drottningholm, Report No. 49, pp. 120-128.

Six hundred and sixty-nine specimens of 11 species of Lake Mälaren fish were examined for parasites of the genus Triaenophorus. Larval stages of T. nodulosus were found in 69% of the perch and 58% of the smelt examined but were not found in burbot or ruffe, which are known European hosts of the parasite, or in any other of the species. A possible strong year class of T. nolulosus in perch was noted. The larval stage of T. crassus was found in 43% of the ciscoes examined. Only one whitefish was examined and T. crassus was not found. The adult stage of both T. crassus and T. nodulosus was found only in the pike. T. nodulosus was more abundant than T. crassus. Ecological relationships of the pike and the several intermediate fish hosts of T. nodulosus and T. crassus in Lake Mälaren are discussed. (Auth. summ.)

**13699.** Aass, Per (Ministry of Agriculture, Vollebekk, Norway). 1969. CRUSTACEA, ESPECIALLY Lepidurus arcticus Pallas, AS BROWN TROUT FOOD IN NORWEGIAN MOUNTAIN RESERVOIRS. Inst. of Freshwater Research, Drottningholm, Report No. 49, pp. 183-201.

The food of brown trout in 38 arctic and subarctic reservoirs in southern Norway was investigated. In August - September, the main feeding season of the mountain trout, crustaceans were the predominant food. In subarctic reservoirs the trout turn to semibenthic Cladocera as their main food. Introductions into subarctic reservoirs of trout populations mainly feeding on Cladocera were started in 1968. The trout living in arctic reservoirs feed to a great extent on Lepidurus arcticus Pallas, which survives annual amplitudes of at least 35 metres. Impoundments create conditions favourable to Lepidurus. The species has extended its downstream distribution by invading subarctic and high boreal lakes. Populations already existing in subarctic lakes have flourished after impoundments. Introductions of Lepidurus into reservoirs where it has no natural access were started in 1967. (Auth. summ.)

**13700.** Hoff, James G. (Southeastern Mass. Univ., No. Dartmouth, Massachusetts). 1971. MASS MORTALITY OF THE CREVALLE JACK, Caranx hippos (Linnaeus) ON THE ATLANTIC COAST OF MASSACHUSETTS. Chesapeake Science, 12(1): p. 49.

A combination of sudden drop in air temperatures and inflow of cold spring water apparently caused the mortality of over 200 crevalle jacks (Caranx hippos) in Slocum River, Massachusetts, observed on October 18, 1969.

**13701.** Dovel, William L., and James R. Edmunds, IV. (Natural Resources Inst., Univ. of Maryland, Solomons, Maryland). 1971. RECENT CHANGES IN STRIPED BASS (Morone saxatilis) SPAWNING SITES AND COMMERCIAL FISHING AREAS IN UPPER CHESAPEAKE BAY; POSSIBLE INFLUENCING FACTORS. Chesapeake Science, 12(1): 33-39.

Chesapeake Bay annually contributes a large percentage of all the striped bass produced in North America. For many years, the lower Susquehanna River was considered the major spawning area in the Bay. Recent evidence suggests that the areas of greatest egg abundance, as well as commercial fishing for striped bass in the upper bay, now occur along the main navigational channel from Worton Point to Chesapeake City on the Chesapeake and Delaware Canal. This shift has apparently resulted from major environmental alterations which have occurred in the last 90 years. The construction of the C & D Canal, at the head of Chesapeake Bay, has increased the total area suitable for species propagation and commercial fishing activities. (Authors)

**13702.** Noble, Richard L. (Dept. of Conservation, Cornell Univ., Ithaca, New York). 1971. AN EVALUATION OF THE METER NET FOR SAMPLING FRY OF THE YELLOW PERCH, Perca flavescens, AND WALLEYE, Stizostedion v. vitreum. Chesapeake Science, 12(1): 47-48.

In three of six meter net-Miller sampler comparisons conducted in 1965, catches of yellow perch fry in Miller samplers were significantly greater than in meter nets. Relative efficiency of the Miller sampler, expressed as the ratio of mean catch per volume in standard Miller samplers to that in meter nets, increased steadily with time to a relative efficiency of 5.62, i.e., an apparent 82% avoidance, when perch fry reached 16.5 mm mean length. A significant positive correlation ($r = .92$) between relative efficiency and mean size of fry in the last five comparisons indicated that avoidance of meter nets increased as fry grew larger. Nevertheless, differences in mean lengths of fry in the two nets were usually small and not significant, even though the standard error of the mean length was generally only 0.2 mm. The low estimate of relative efficiency in the first comparison (.41 when perch fry averaged 9.1 mm) may have been the result of a change in distribution of fry within the time interval between the two series of samples. The difference could not be attributed to escapement of small fry through the meshes, since there was no deficiency of smaller fry in the Miller sampler catch. Because walleye fry density was much lower than that of yellow perch, avoidance of meter nets by walleyes was less well defined. Although more walleye fry were caught in Miller samplers than in meter nets in all comparisons, catches were significantly greater on only two days. The meter net has been clearly shown to be inadequate for sampling fry of the yellow perch and walleye during daylight hours. Avoidance apparently can begin when fry are less than 10 mm long, and increases rapidly thereafter. The rate of avoidance, however, may be greater than indicated by these evaluations, since avoidance of Miller samplers can also occur. (Auth. results and discussion)

**13703.** Khokhar, R. (Dept. of Zool., Bedford College Annex, London N. W. 1, England). 1971. EXPERIMENTAL EVIDENCE OF INHIBITORY CONTROL OF PARS INTERMEDIA FUNCTION AND THE RATE OF RECOVERY OF FUNCTION AFTER DENERVATION IN THE TELEOST Ictalurus melas. Experientia, 27(3): 340-341.

The effects of denervation of the pars intermedia (PI) of the pituitary gland on the melanophores in I. melas (in which MSH plays an important role in the color changes) are reported. The immediate effect of interrupting the hypothalamo-hypophyseal tract on the melanophores of white-adapted animals was of full dispersion of pigment [MI (melanophore index) 5.0]. 1-3 days after the operation there was a considerable aggregation of pigment and the MI became relatively stable (3.2-3.3). No significant change in the melanophores in the next 2 months was detected and white background adaptation of the animals remained impaired. The animals retained their ability to adapt to a black background. The fish appeared to gradually regain their ability to adapt to a white background about 2 months after the denervation of the PI and in about 4 months they appeared to be able to concentrate their melanophores almost completely. In controls white/black background adaptation was unaffected.

**13704.** Vielkind, J., Ursula Vielkind, Erdmuthe von Grotthuss, and F. Anders (Genetisches Institut der Justus-Liebig-Universität, Leihgesterner Weg 112-114, D-63 Giessen, West Germany). 1971. UPTAKE OF BACTERIAL $H^3$-DNA INTO FISH EMBRYOS. Experientia, 27(3): 347-348.

Since the experiments with bacteria which have shown that genetic transformation can be produced by adding extraneous DNA to bacterial cultures, many attempts have been undertaken to achieve transformation in higher organisms. Since most of the high-molecular DNA taken up by mammalian cells is usually rapidly degraded, the fate of bacterial $H^3$-DNA injected into fish embryos was investigated. During the first few hours, nearly all radioactivity injected (= 100%) is associated with acid-insoluble material in the yolk. Then it decreases, reaching a level of about 40% at 40 h. During the same period, there is an accumulation of radioactivity in the yolk supernatant, reaching a maximum of 45% at 45 h. During the following hours, this radioactive acid-soluble material decreases rapidly to about 30% between 45 and 75 h and then levels off to about 20%. Part of $H^3$-DNA injected into the yolk of fish embryos is degraded. The degradation products are taken up from the acid-soluble fraction of the yolk into the embryo, where they are used for DNA synthesis. A relatively high percentage of the radioactivity injected is still present in the acid-insoluble fraction of the yolk. Since it has not yet been shown that DNA synthesis takes place in the yolk, one can assume that this fraction still contains fairly high-molecular bacterial DNA. Thus, there might be a good chance that this high-molecular DNA could be incorporated into the embryo cells. Further experiments to clarify whether high-molecular DNA can be incorporated are now in progress.

**13705.** Hirano, Tetsuya, Donald W. Johnson, and Howard A. Bern (Bodega Mar. Lab., Dept. of Zool. and Cancer Res. Genetics Lab., Univ. of Calif., Berkeley, California). 1971. CONTROL OF WATER MOVEMENT IN FLOUNDER URINARY BLADDER BY PROLACTIN. Nature, 230(5294): 469-471.

There has been no direct physiological evidence of osmoregulatory activity of the teleost urinary bladder. This question was investigated using isolated bladders from the euryhaline flounder, Platichthys stellatus. The results indicate that the teleost urinary bladder, at least in the starry flounder, may play an important role in osmoregulation by modifying the concentration of the urine, and could thereby make a contribution to hydromineral balance more important than mere storage and expulsion of urine.

**13706.** Howell, W. M., and C. R. Duckett (Dept. of Biol., Samford Univ., Birmingham, Alabama). 1971. SOMATIC CHROMOSOMES OF THE LAMPREY, Ichthyomyzon gagei (AGNATHA: PETROMYZONIDAE). Experientia, 27(2): 222-223.

Study of the somatic chromosomes of a North American lamprey, Ichthyomyzon gagei Hubbs and Trautman shows that the diploid chromasomal equipment is composed of 164 chromosomes, which are acrocentric or telocentric and very small (less than 3.5μm). There are no differences between the karyotype of I. gagei and that of Lampetra aepyptera (Abbott). The relationships of I. gagei with the other lampreys and the evolution of the karyotype are examined. (Authors resume)

**13707.** Kroger, Richard I., Robert L. Dryfoos, and Gene R. Huntsman (NMFS, Center for Estuarine and Menhaden Res., Beaufort, No. Carolina). 1971. MOVEMENT OF JUVENILE ATLANTIC MENHADEN TAGGED IN NEW ENGLAND WATERS. Chesapeake Science, 12(2): 114-115.

Juvenile Atlantic menhaden, Brevoortia tyrannus Latrobe, are common during the summer in estuaries from northeastern Florida to the Gulf of Maine. The winter fate of those juveniles produced from Long Island Sound northward has been unknown. One thousand and twenty juveniles were tagged on 9 October 1969 in Winnapaug Pond, R. I. near the Connecticut-Rhode Island boundary. Recoveries of tagged menhaden indicate that some juveniles migrate south during the fall and remain in the South Atlantic area during the following spring and summer. That some northern juveniles survived and migrated to the South Atlantic States supports the hypothesis of fall southward migration and integration of northern grown juveniles with those produced off the mid- and South Atlantic States.

**13708.** Maekawa, Koji, and Juro Yamada (Lab. of Physiol. and Ecol., Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. SOME HISTOCHEMICAL AND FINE STRUCTURAL ASPECTS OF GROWING SCALES OF THE RAINBOW TROUT. Bull. Fac. Fish. Hokkaido, 21(2): 70-78. In English.

Some histochemical and electron microscope observations on the growing scale of juvenile and young rainbow trout were made with a particular note on the structure of the growing margin, an osteoid zone. The upper layer of the scale is shown histochemically to be mainly composed of neutral heteropolysaccharides, acidic sulfated mucopolysaccharides and collagen. Most of the reactions tested are more intense in the osseous layer than in the osteoid zone. Both metachromasia with toluidine blue and Alcian blue staining are negative or weakly positive in the osteoid zone in correspondence with negative reaction for calcium salts. Electron microscopy revealed the occurrence of the following characteristic-substances or structures in the growing scale matrix: (1) fine collagen fibers (300 A) filling the intercellular spaces between marginal scale-forming cells, (2) dense amorphous ground substance in addition to the collagen fibers in the osteoid zone, and (3) a transitional increase of dense particles within the amorphous substance from the osteoid zone to the osseous zone. Incipient mineral crystals appear within these dense particles. In considering the histochemical evidence in connection with the electron microscope observation, an intimate relation to the calcification of the scale may possibly be associated with sulfated mucopolysaccharides of the dense particles and also with PAS-positive materials of the amorphous ground substance. The lamellar structure of the fibrillary plate is formed by an alteration in the orientation of 600 A collagen fibers cemented by PAS-positive materials. (Authors summ.)

**13709.** Wilkens, E. Peter H., and Robert M. Lewis (NMFS, Center for Estuarine and Menhaden Res., Beaufort, No. Carolina). 1971. OCCURRENCE OF REVERSAL AND STAINING IN NORTH CAROLINA FLOUNDERS. Chesapeake Science, 12(2): 115-116.

Juvenile flounders showing blind side pigmentation and reversal were caught in two North Carolina estuaries. Six ocellated flounders, Ancylopsetta quadrocellata (Gill), with pigmented blind sides, were taken in the lower Newport River estuary on March 19, 1968. A young reversed bay whiff, Citharichthys spilopterus (Gunther), was caught on July 16, 1969. All specimens are deposited in the collections of the Center for Estuarine and Menhaden Research, Beaufort, North Carolina.

**13710.** Davis, Robert M. (Univ. of Maryland, Natural Resources Inst., LaVale, Maryland). 1971. LIMNOLOGY OF A STRIP MINE POND IN WESTERN MARYLAND. Chesapeake Science, 12(2): 111-114.

This paper reports an 11-month study of physical and chemical characteristics of a 100-acre strip mine pond being used for fish production. Several species of warm and cold water game fish have been stocked in the lake. The more important findings included pH values ranging from 5.5 to 6.8, with a net alkalinity below 20 ppm and total iron ranging from 0.16 to 11.20 ppm. (Auth.)

**13711.** Jamsen, Gale C., and Paul V. Ellefson. 1970. MICHIGAN'S 1970 SPORT FISHERY, JANUARY 1 - APRIL 24. Mich. Dept. of Natural Resources Research and Development Report No. 211, 4 p. plus appendix and tables.

Sport fishermen of Michigan were surveyed as to their fishing activity between January 1 and April 24, 1970. The intent of the survey was to assess the recreational benefits that result from sport fishing in Michigan. Such an assessment will aid in guiding public and private investment in fishing and related programs. Approximately 320,000 fishermen purchased a Michigan fishing license during Period I of 1970 (January 1 - April 24). Of this total, five percent were non-residents. Nearly all the non-residents (97 percent) resided in Ohio, Indiana, Illinois, and Wisconsin. Fishermen actually exercising their license to fish numbered 190,000 during Period I. Forty-four percent of this total fished on the Great Lakes and their tributary streams and 70 percent fished on inland lakes and streams. Michigan's sport fishing activity during Period I of 1970 totaled nearly 2,000,000 angler days. Seven out of every ten of these angler days occurred on a Michigan inland lake or stream.

**13712.** Shaw, Evelyn, and Richard A. W. Sherman (Dept. of Animal Behavior, the American Mus. of Natural History, New York, New York). 1971. THE OPTOMOTOR RESPONSE OF A FOREBRAINLESS FISH, Tilapia mossambica. Amer. Mus. Novit., No. 2446, pp. 1-16.

The forebrain was removed from Tilapia mossambica, a cichlid fish that shows schooling behavior. The fish was tested in an optomotor apparatus before and after forebrain ablation. After ablation, there were significant decrements in fish r.p.m. in relation to drum r.p.m. and in the ability of the fish to reverse direction when drum direction was reversed. The relevance of these findings to schooling is discussed. (Authors summ.)

**13713.** Smith, C. Lavett, and Charlie R. Powell (Dept. of Ichthyology, the Amer. Mus. of Natural History, New York, New York). 1971. THE SUMMER FISH COMMUNITIES OF BRIER CREEK, MARSHALL COUNTY, OKLAHOMA. Amer. Mus. Novit., No. 2458, pp. 1-30.

Seven stations in a small stream in southern Oklahoma were studied weekly during June and July, 1969. Thirty-three species were collected and these fall into three assemblages. An upstream ephemeral assemblage, a midstream pool and riffle assemblage, and a downstream baselevel assemblage. These communities are distinguishable on the basis of faunal lists, relative numbers, relative biomass, and consistency of occurrence as measured by percentage of the samples in which the species are present. Multivariate analysis permits the degree of resemblance between the stations to be expressed objectively and also provides a convenient means of assessing the relative roles of the component species. Faunal lists provide the least amount of information; calculations based on relative numbers and relative biomass give more meaningful results. Diversity indices are commonly used expressions of relative abundance. These were calculated for each sample and their trends and fluctuations during the sample period are examined for each station. These indices are useful tools but have the drawback of ignoring the identity of the component species. Resource-sharing patterns in the three communities are discussed briefly. (Authors summ.)

**13714.** Williams, Madelaine M., and Evelyn Shaw (Hunter College, The City Univ. of N. Y., New York, New York). 1971. MODIFIABILITY OF SCHOOLING BEHAVIOR IN FISHES: THE ROLE OF EARLY EXPERIENCE. Amer. Mus. Novit., No. 2448, pp. 1-19.

More than one thousand Menidia menidia, a schooling fish, were reared from the embryonic stage to the schooling stage under two environmental conditions, namely, together in aquarium tanks and separately in styrofoam cups. Many individually reared fish, the isolates, were given a single exposure with age peers at some point during their development. A number of individually reared fish that had contact showed behavioral modifications when compared with the isolates that were not given such an experience. Schooling behavior was modified among the isolates. Withdrawal behavior, which normally decreases when the schooling tendency is established continued to be seen at a significantly high level during the schooling phase. A new behavior, named lateral turning, was observed. Apparently, as a consequence of the continued high withdrawal rate and the lateral turning, the schooling organization was different among the isolates when compared with the schooling organization of the fish reared together in aquarium tanks. (Authors summ.)

**13715.** Shaw, Evelyn (Dept. of Animal Behavior, the Amer. Mus. of Natural History, New York, New York). 1969. THE DURATION OF SCHOOLING AMONG FISH SEPARATED AND THOSE NOT SEPARATED BY BARRIERS. Amer. Mus. Novit., No. 2373, pp. 1-13.

Experiments were carried out to determine whether or not the duration of schooling was equivalent among fish separated by barriers and those not separated by barriers. The barriers were either transparent or they partly occluded vision. The results showed that the time pairs of fish spent oriented parallel to one another when separated by barriers was significantly less than the time other pairs of fish spent oriented parallel when they were not separated by barriers. (Auth. summ.)

**13716.** Cowey, C. B., J. W. Adron, A. Blair and J. Pope (Nat. Environ. Res. Council Fish. Biochem. Res. Unit, Univ. of Aberdeen, Aberdeen, Scotland). 1970. THE GROWTH OF O-GROUP PLAICE ON ARTIFICIAL DIETS CONTAINING DIFFERENT LEVELS OF PROTEIN. Helgoländ. wiss. Meeresunters., No. 20, pp. 602-609. In English.

Group-O plaice, Pleuronectes platessa L., were grown on partially defined diets containing different levels of protein. The growth rate appeared to increase linearly as the protein content of the diet was increased up to the highest level used (70% of the dry diet). A conversion rate of 1.6 was obtained with diets containing 50% or more of protein. The protein efficiency ratio on all diets was near unity. The maximum value obtained being 1.16 with the 50% protein diet. (Authors summ.)

**13717.** Vallet, F., J. Berhaut, C. Leray, B. Bonnet, and P. Pic (Station Marine d'Endoume et Centre d'Oceanographie; Marseille, France). 1970. PRELIMINARY EXPERIMENTS ON THE ARTIFICIAL FEEDING OF MUGILIDAE. Helgoländ. wiss. Meeresunters., No. 20, pp. 610-619. In English.

A diet rich in proteins is necessary for the growth of very young Mugil auratus and M. capito (standard length: 21 mm). As soon as the natural change of diet occurs, a smaller quantity is sufficient. The nature of proteins, incorporated in the food, does not seem to influence conversion rates. Under conditions of complete starvation, a solution of urea at a concentration of 4 g/l reduces weight loss in young Mugil capito (1.5% instead of 23% loss after 9 days' starvation). At 15°C, 10 g Mugil auratus require a daily maintenance ration of 0.92 Cal; a ration of 1.8 Cal facilitates a higher growth efficiency (7% in 3 weeks). The addition of non-assimilable components reduces the rate of utilization of assimilable food substances. Salinity influences food conversion rate. A salinity of 20% affords maximum growth and highest efficiency of food turnover. (Authors summ.)

**13718.** Jatzke, P. (Biologische Anstalt Helgoland (Meeresstation); Helgoländ, Germany (FRG). 1970. THE TRICHTERKREISEL, AN IN SITU DEVICE FOR CULTIVATING MARINE ANIMALS IN TIDAL CURRENTS. Helgoländ. wiss. Meeresunters., No. 20, pp. 685-690. In English.

Cultivation of marine animals in the open sea requires development of special equipment. The trichterkreisel facilitates maintenance and cultivation of several marine animals (Homarus gammarus, Galathea squamifera, Mytilus edulis, and others). It represents, in essence, an upright standing cylinder, into which tidal currents enter at the bottom, rotate and slowly leave at the top through a gauze cover. Small plankton organisms enter the trichterkreisel with the water flow, passing through gauze-covered frames and thus provide food for the animals cultivated. Some of the plankton forms metamorphose and grow in the device until devoured. During a 17 months' experiment a young lobster Homarus gammarus grew at a normal rate in a trichterkreisel without any artificial feeding. A large in situ trichterkreisel for cultivating masses of lobster larvae is planned for the near future. (Auth. summ.)

**13719.** Davis, W. P. (Aquatic Sciences, Inc., Boca Raton, Florida). 1970. CLOSED SYSTEMS AND THE REARING OF FISH LARVAE. Helgoländ. wiss. Meeresunters., No. 20, pp. 691-696. In English.

Various designs and techniques of closed system rearing of fish larvae are being developed using specific species chosen on the basis of their reproductive habits, ecological preference, and potential as environmental indicators. The influence of the parameters of temperature, salinity, food, light, circulation, and the presence of autotropic organisms are tested using as criteria for the success of hatch and development. To date, the results have produced several techniques which increase the percentage of success in raising fry and juvenile fishes. (Auth. summ.)

**13720.** von Westernhagen, H. (Inst. für Hydrobiologie und Fischereiwissenschaft der Universität Hamburg, Hamburg 50, Deutschland (BRD). 1970. REARING THE EGGS OF COD (Gadus morhua), FLOUNDER (Pleuronectes flesus) AND PLAICE

(Pleuronectes platessa) UNDER COMBINED TEMPERATURE AND SALINITY CONDITIONS. Helgoländ. wiss. Meeresunters., No. 21, pp. 21-102. In German with English abstract.

Eggs of Baltic cod (Gadus morhua L.), flounder (Pleuronectes flesus L.) and plaice (Pleuronectes platessa L.) have been reared under combined temperature and salinity conditions (0°-16°C, 7 °/oo-42 °/oo S). Combined temperature and salinity influences on embryonic development were investigated. Optimum temperatures for the rearing of cod eggs range from 4° to 8°C, and optimum salinities from 20 °/oo to 35 °/oo S. Flounder eggs develop best at 4°C and in 33 °/oo S, and plaice eggs at 6°C and in 20 °/oo S. Suboptimum conditions result in lower percentages of larval hatching and survival, and increased morphological anomalies such as curvature of tail and body. Low salinities (20 °/oo and 15 °/oo S) cause swollen yolk sacs which, in experiments with flounder eggs, lead to jaw deformities. Rearing at low salinity decreases speed of development. Optimum salinity varies as a function of incubation temperature and influences variations in optimum rearing temperature. Extremely low salinities (20 °/oo and 15 °/oo S) are tolerated best at optimum or lower temperatures. From the results of these experiments it can be concluded that brackish water races of these fishes are likely to exist in the Baltic Sea. (Auth.)

13721. Rottschafer, J. Mark, John D. Jones, and Harry B. Mark, Jr. (Dept. of Chemistry, Univ. of Mich., Ann Arbor, Michigan). 1971. A SIMPLE, RAPID METHOD FOR DETERMINING TRACE MERCURY IN FISH VIA NEUTRON ACTIVATION ANALYSIS. Environmental Science & Technology, 5(4): 336-338.

A simple, rapid neutron activation method for mercury in fish tissue is described. The technique employs separation of the activated mercury as an $HgCl_4^{2-}$ complex on an anion-exchange resin and direct counting of the resulting resin. Results showed that the analyses have a $\pm$ 10% standard deviation for tissue samples containing mercury in the 0.05 to 10 ppm range, and the sensitivity has an approximate 3-ppb limit for the conditions employed. Example results for mercury content in different fish species from a variety of locations and different fish organs are given. Also, the results of replicate samples analyzed by a variety of different methods and in different laboratories are compared. (Authors)

13722. Zaugg, W. S., and L. R. McLain (Western Fish Nutrition Lab., Bur. of Sport Fish. and Wildl., Cook, Washington). 1971. GILL SAMPLING AS A METHOD OF FOLLOWING BIOCHEMICAL CHANGES: ATPASE ACTIVITIES ALTERED BY OUABAIN INJECTION AND SALT WATER ADAPTION. Comp. Biochem. Physiol., Vol. 38(3B): 501-506.

A method of sampling gills of individual fish was used to follow changes in ATPase activities resulting from ouabain injection or salt-water adaption of coho salmon (Oncorhynchus kisutch). Ouabain inhibited Na+, K+-stimulated ATPase activity by 40 to 50 percent in microsomes of fresh-water fish and 80-90 percent in those adapted to salt water. A decrease in $Mg^{2+}$-dependent ATPase activity which accompanies increased Na+, K+-stimulated activity as coho salmon adapt to salt water may reflect conversion of one form of the enzyme to another. (Authors)

13723. Sano, Tokuo (Res. Lab. of Fish. Resources, Tokyo Univ. Fish., Minato-ku, Tokyo 108, Japan). 1970. ETIOLOGY AND HISTOPATHOLOGY OF SEVERAL EPIZOOTICS AMONG FINGERLING SALMONIDS. J. Tokyo Univ. Fish., 56(1-2): 13-22. In English.

The diseases of fingerling trout occurred in trout farms and hatcheries were studied etiologically and histopathologically, 1963 to 1967. Three cases out of seventeen epizootics with high mortality were identified as the unknown disease on the basis that they showed no detectable pathogen. Their histopathological findings revealed the change which is similar to IPN in the United States. Other diseases were caused by protozoa, bacteria, fungi and trematode which are relatively common in fish farms. Among the fishes some of them were due to simultaneous occurrence of the detectable pathogen. (Auth.)

**13724.** Sano, Tokuo (Res. Lab. of Fish. Resources, Tokyo Univ. Fish., Minato-ku, Tokyo 108). 1970. ETIOLOGY AND HISTOPATHOLOGY OF HEXAMITIASIS AND AN IPN-LIKE DISEASE OF RAINBOW TROUT. J. Tokyo Univ. Fish., 56(1-2): 23-30. In English.

In this study, hexamitiasis and the unknown disease were studied with more emphasis to clarify the epizootic characters. In the intestine of hexamitiasis-fish, a lot of the flagellates were found and the infected fish showed the development of catarrhal enteritis which eventually results in the desquamation of the epithelium of the intestine. Some trout with hexamitiasis showed simultaneous infection with the unknown disease. 450 mμ- and 100 mμ-filtrate prepared from the unknown diseased fish revealed the infectivity to rainbow trout fry. While 450 mμ-filtrate heated at 60°C for 30 minutes showed no infectivity. And also, RNA cytoplasmic inclusion bodies were found in the pancreas of the unknown diseased fish. These facts show that the unknown disease could be suspected as the viral epizootic which is similar to IPN. (Auth.)

**13725.** Merna, James W., Michael E. Bender, and James R. Novy (Inst. for Fish. Res., Mich. Dept. of Natural Resources, Ann Arbor, Michigan). 1970. THE EFFECTS OF METHOXYCHLOR ON FISHES. I. ACUTE TOXICITY AND BREAKDOWN STUDIES. Mich. Dept. of Natural Resources Res. and Development Report No. 217, 15 p.

A series of experiments is being conducted which are designed to determine the potential dangers which may result from increased use of methoxychlor in the environment. This paper presents data on the first two phases of the study, i.e., breakdown experiments and acute toxicity studies. The estimated half life of methoxychlor in distilled water is 270 days. Hydrogen ion concentration within the range studied (pH 7-9) had no effect on the breakdown rate. In aged Ann Arbor tap water which had previously held fish, the half life was 8 days. In two experiments conducted with water from Koch Warner Creek, two different loss rates were apparent in the data. Measured half life was 7 days in the June experiment, and (by extrapolation) 18 days in the July trial. The static 96-hour $TL_{50}$ values obtained during the experiments were 7.5 μg/l for fathead minnows and 30.0 μg/l for yellow perch.

**13726.** Bennett, David H. (Pt. Pleasant, West Virginia). 1971. PRELIMINARY EXAMINATION OF BODY TEMPERATURES OF LARGEMOUTH BASS (Micropterus salmoides) FROM AN ARTIFICIALLY HEATED RESERVOIR. Arch. Hydrobiol., 68(3): 376-381.

Body temperatures of nearly 600 largemouth bass (Micropterus salmoides) from a 1,120 ha reservoir (Par Pond) receiving heated water from a nuclear reactor were measured from October 1969 to February 1970. A study area was established at the entrance of the heated effluent and a control area at the outflow dam, approximately 4.8 km from the heated area. Bass captured in the heated environment had significantly higher monthly body temperatures than those from the control area. Body temperatures of bass from the heated area ranged from 12.0 to 32.0°C. No correlation was found between body condition (K. factor) of bass from the heated environment and body temperature at capture suggesting fish either had a sufficient food supply to maintain their body condition at higher temperatures or were temporarily emigrating to cooler areas. (Auth.)

**13727.** Graham, Jeffrey B. (Smithsonian Tropical Res. Inst., Balboa, Canal Zone). 1971. TEMPERATURE TOLERANCES OF SOME CLOSELY RELATED TROPICAL ATLANTIC AND PACIFIC FISH SPECIES. Science, 172(3985): 861-863.

Species of Pacific shallow-water fish are more tolerant of low temperatures than Atlantic species are. At high temperatures Atlantic species are more tolerant than Pacific species. For species pairs of Bathygobius differences in the tolerance of low temperatures are small and can be removed by acclimation to 23°C. Differences in the tolerance to low temperature in transisthmian species of Apogon, however, are large and persist after acclimation to 23°C. Some Pacific species adapt

to the cooler temperatures of their habitat through increasing their rates of oxygen consumption at ambient temperatures or decreasing the dependence of oxygen uptake rate on temperature, or both. (Auth.)

13728. Pasternak, Kazimierz. 1971. THE INFLUENCE OF WATERS POLLUTED WITH COLLIERY WASTES ON THE PROPERTIES OF THE BOTTOM SOIL OF CARP PONDS. Acta Hydrobiol. Krakow, 13(1): 59-76.

Investigations were carried out on changes in the properties of heavy bottom soils of ponds under the influence of water polluted with wastes from a mine of pit coal. It was found that in the upper layer of polluted soils, apart from a change in the grain size composition and a very large increase in acidity and in the amount of organic matter, there also occurs a marked concentration of some chemical constituents. The increase in the content of sulphur (chiefly in the form of sulphates and free $H_2SO_4$), aluminium, total phosphorus, and exchangeable sodium and magnesium is particularly strongly marked. The degree of their salinity is relatively low. Soils of ponds supplied with water in the first sequence are subject to the greatest pollution. A high percentage of organic matter of polluted soils consists of free compounds of fulvic and himic acids, bitumens, and phenols. The paper ends with a discussion on the detrimental effects of this phenomenon and on the means of preventing them. (Auth.)

13729. Bernatowicz, Stanislaw, and Leon Sawicki. 1971. OBSERVATION OF THE ACCLIMATIZATION OF Coregonus peled (Gmel.) IN THE WATERS OF NORTH-EAST POLAND. Acta Hydrobiol. Krakow, 13(1): 43-58.

Investigations on the growth of Coregonus peled in ponds and lakes were carried out from their hatching up to the third year (2+). In ponds the weight of autumn fry was 21.6 - 23.2 g and their survival rate was 7.3 - 11.8 percent. In the second year (1+) Coregonus peled reached a weight of 252 g and in the third year (2+) 500 g. Their survival was 48.7 percent in the second year and 63.0 percent in the third. In lakes the Coregonus peled rate of growth was similar to that in the northern waters, whereas in the Lake Dobskie it surpassed all known cases in this respect. In 1968 the spawning-time of Coregonus peled was from 6th to 19th December at a water temperature of 1.0°C to 0.5°C. (Authors)

13730. Bridges, David W. (Dept. of Zool., No. Carolina State Univ., Raleigh, North Carolina). 1971. THE PATTERN OF SCALE DEVELOPMENT IN JUVENILE ATLANTIC CROAKER (Micropogon undulatus). Copeia, No. 2, pp. 331-332.

To determine the pattern of scalation a sample of 106 croakers (Micropogon undulatus) taken by a Gulf V high-speed plankton sampler in the Cape Fear River Estuary 37 km from its mouth, 10 January 1970, was stained with alizarin red in a weak KOH solution, cleared in KOH/glycerin solutions, and stored in glycerin. This method allowed accurate measurement of standard length since the entire skeleton was visibly stained. All measurements were made with an ocular micrometer. Stage 1 (14.2-15.0 mm SL) contains the unscaled fish. Scales first appear along the lateral line of the caudal peduncle (14.1-16.0 mm). The lower half of of the peduncle is covered first (14.1-22.3 mm). Scalation proceeds anteriorly along the lateral line and encloses the area forward of the caudal fin between the insertions of the soft dorsal and anal fins (15.3-17.8 mm). The lateral line scales continue to develop forward to a point nearly even with the origin of the spiny dorsal fin with very little increase in body scalation forward of the dorsal and anal fin insertions (17.3-20.9 mm). By the time the lateral line scales have reached the gill opening, the body has been covered to a level midway on the spiny dorsal and just forward of the anus (18.5-20.8 mm). At the gill opening, scalation progresses ventrally from the lateral line toward the belly and scales appear for the first time on the breast (18.7-23.7 mm). Body scalation progresses from the lateral line anteroventrally halfway to the breast and anterodorsally to the origin of the dorsal fin as scales first appear on the cheek beneath the eye and on the head directly between the eyes (22.0-24.3 mm). Scales appear then in patches around the eye, on the opercular and preopercular bones, and in the region of the nape, while the breast becomes nearly covered (25.3-31.0 mm). The head becomes completely scaled as well as the nape and breast, and scalation is completed (31.7-37.9 mm).

**13731.** Watson, D. G., C. E. Cushing, C. C. Coutant, and W. L. Templeton (Ecosystems Dept., Battelle Mem. Inst., Pacific Northwest Labs., Richland, Washington). 1970. CYCLING OF RADIONUCLIDES IN COLUMBIA RIVER BIOTA. Proc. of Univ. of Missouri's 4th Ann. Conf. on Trace Substances in Environmental Health, June 23, 24, 25, 1970.

A study of the cycling of six radionuclides in Columbia River biota was initiated in February 1966 to define the interspecies and seasonal variations in concentrations. These data were related to major ecological factors such as light, temperature, flow, and stable element concentrations. Concentrations of radionuclides in Columbia River water are generally inversely proportional to flow levels, with highest values in winter and lowest in summer. This is related to dilution by seasonal run-off. $^{32}P$, $^{65}Zn$, and $^{51}Cr$ were the elements present in highest concentrations in the biota. Levels followed a pattern of high levels in winter and low values in summer. This relationship was particularly apparent in those organisms with high surface to volume ratios whose dominant mode of uptake is adsorption. The influence of the seasonal run-off overwhelmed the beneficial effects of seasonal changes in light and temperature in spring. The magnitude of seasonal changes decreased in the higher trophic levels. Concentration factors (CF) were highest for the biologically important radionuclides $^{32}P$ and $^{65}Zn$ and were highest in the primary producers. CFs decreased in higher trophic levels. (Authors)

**13732.** Smith, Carolyn D., and J. G. Eales (Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada). 1971. INFLUENCE OF ACCLIMATION TEMPERATURE ON RATE CONSTANTS FOR THYROID UPTAKE OF IODIDE BY BROOK TROUT, Salvelinus fontinalis (Mitchill). Canad. J. Zool., 49(5): 783-786.

A procedure for determining the rate constant for thyroid iodide uptake for fish is described. Rate constants for thyroid iodide uptake in brook trout agreed with previously used indices of thyroid activity (T/S and CR) in indicating a more active thyroid at 16C than 10C. At both temperatures radioiodide metabolism was extremely slow with considerable variation between individual fish. These features may be attributed to the high and variable serum stable iodide level in this species. (Authors)

**13733.** Becker, C. D. (Ecosystems Dept., Battelle Mem. Inst., Pacific Northwest Lab., Richland, Washington). 1970. FEEDING BIONOMICS OF JUVENILE CHINOOK SALMON IN THE CENTRAL COLUMBIA RIVER. Northwest Sci., 44(2): 75-81.

Juvenile chinook salmon (Oncorhynchus tshawytscha) feed primarily upon aquatic insects (96% of their diet) during their temporary spring sojourn in the free-flowing central Columbia River, Washington. Adult and larvae Tendipedidae (Diptera) dominated the food organisms consumed (81% of numerical total) whereas the orders Trichoptera (5) and Hemiptera (4%) were of secondary importance. Hydroelectric development has inundated most of the mainstem Columbia, therefore the data relate to food habits of young chinook in a surviving natural environment. (Auth.)

**13734.** Jensen, Albert C. (Div. of Marine and Coastal Resources, N. Y. State Dept. of Environmental Cnnservation). 1970. THERMAL LOADING IN THE MARINE DISTRICT. N. Y. Fish Game J., 17(2): 65-80.

Increased development of steam electric stations in New York's Marine District is resulting in considerable thermal loading of the marine waters. The Marine District includes part of the lower Hudson River, the New York side of Long Island Sound and the Atlantic Ocean out to the 3-mile limit. Fossil- and nuclear-fuel plants use the Hudson for coolant water, and more nuclear plants are planned for the river. Three fossil-fuel plants are operating on Long Island Sound and two nuclear-fuel plants are planned. Two fossil-fuel plants are operating on the south shore of Long Island. Potential thermal discharge into the lower Hudson River is 3.0 billion gallons per day. Potential discharge on New York's side of Long Island Sound is 8.2 billion gallons per day. Temperature increase above ambient is between 20° and 30°F. The Hudson River and Long Island Sound support important commercial and recreational fisheries. Thus, the possibility of ecological damage is a serious consideration. (Auth.)

**13735.** Noble, Richard L. (Dept. of Conservation, Cornell Univ., Ithaca, New York). 1970. PARASITES OF YELLOW PERCH IN ONEIDA LAKE NEW YORK. N. Y. Fish Game J., 17(2): 95-101.

Parasites of 54 yellow perch from Oneida Lake, New York, in 1966 were compared with those found over 35 years earlier. The trematodes Tetracotyle sp., Apophallus brevis and Urocleidus adspectus, previously unrecorded from perch in Oneida Lake, have become common, but Clinostomum marginatum, previously common, was not found. Some of these changes may be related to changes in the bottom fauna. Changes in incidence of other trematodes, cestodes, acanthocephalans and nematodes were probably the result of areal and seasonal differences in sampling. (Auth.)

**13736.** Lackey, Robert T. (Dept. of Fishery and Wildlife Biol., Colorado State Univ., Fort Collins, Colorado). 1970. OBSERVATIONS ON NEWLY INTRODUCED LANDLOCKED ALEWIVES IN MAINE. N. Y. Fish Game J., 17(2): 110-116.

Three Maine lakes were stocked in 1966 with landlocked alewives taken from Cayuga Lake, New York. Two lakes supported alewives in 1969. Spawning activity apparently took place from about mid-June to mid-August. Growth of both transplanted alewives and their progeny was very rapid. Alewives occupied the mid- to upper water in summer and fall, but descended to deeper water in winter and spring. The food of alewives was almost entirely microcrustacea, although a few insects were eaten. (Auth.)

**13737.** Becker, C. Dale (Ecosystems Dept., Battelle Mem. Inst., Pacific Northwest Labs., Richland, Washington). 1971. Cestrahelmins rivularis sp. n. (DIGENEA: DEROPRISTIIDAE) FROM WHITE STURGEON Acipenser transmontanus, IN THE COLUMBIA RIVER, WASHINGTON. Reprint from Proc. of the Helminthological Soc. of Wash., 38(1): 23-26.

Cestrahelmins rivularis sp. n. is described from the intestine of white sturgeon, Acipenser transmontanus Richardson, in the central Columbia River, State of Washington, USA. C. rivularis and C. laruei Fischthal, 1957 are the two existing representatives of the genus and of the subfamily Cestrahelminthinae Peters, 1961 (emended from Cestrahelminae). C. rivularis is differentiated from C. laruei by the following features: 1) distinct prepharynx, 2) genital pore with prominent sphincter, 3) unswollen forebody, 4) vitellaria extending anterior to the ventral sucker, 5) metraterm tubular, not saccular, 6) body spines uniform in size and distribution, and 7) seminal receptacle overlapping only the anterior testis. This initial record of Cestrahelmins from sturgeon family Acipenseridae, supports morphological studies which demonstrate close affinities between the Cestrahelminthinae and Deropristinae, within the family Deropristiidae Skrjabin, 1958. (Auth.)

**13738.** Smit, H., J. M. Amelink-Koutstaal, J. Vijverberg, and J. C. Von Vaupel-Klein (Zool. Lab., Div. of Physiology, Univ. of Leiden, The Netherlands). 1971. OXYGEN CONSUMPTION AND EFFICIENCY OF SWIMMING GOLDFISH. Comp. Biochem. Physiol., 39(1A): 1-28.

Simultaneous measurements of oxygen consumption rate and swimming speed were performed on goldfish forced to swim at various velocities. Experiments were done at four temperatures (15, 20, 25 and 30°C) to which the fish had been acclimated. The work done by the swimming fishes was assessed and their efficiency calculated from the ratio of work performed over net rate of oxygen consumed. Efficiency (E) appeared to increase with increasing swimming speeds (V), according to $E = 0.031V^{1.65}$, and to be linearly related to the force exerted by the propulsion muscles. It is concluded that swimming goldfish use red and white muscle fibres simultaneously. (Authors)

**13739.** Dechtiar, Alex O. (Res. Branch, Ont. Dept. of Lands and Forests, Maple, Ontario, Canada). 1971. Pseudacolpenteron pavlovskii Bychowsky and Gussev, 1955 (MONOGENEA) FROM GREAT LAKES CARP, Cyprinus carpio L. Canad. J. Zool., 49(4): 571-572.

The first Canadian record of Pseudacolpenteron pavlovskii Bychovsky and Gussev, 1955 is presented for carp, Cyprinus carpio L., from the Great Lakes. Eggs are described for the first time. (Auth.)

**13740.** Gras, Jean, H. Perrier, C. Perrier, and Y. Gudefin (Dept. of Pharm. Biochem., Fac. of Medicien and Pharmacy, 8 Rockefeller Ave., 69 Lyon (8e), France). 1971. ADRENALINE ACTIVITY ON EXTRACELLULAR FLUID COMPARTMENTS OF THE LATERAL MUSCLE OF THE RAINBOW TROUT (Salmo gairdnerii Richardson): EFFECT OF ADRENERGIC BLOCKING AGENTS. Comp. Biochem. Physiol., 39(1A): 45-51.

The rainbow trout lateral muscle extracellular fluid compartment was studied in vitro by measurement of inulin space and kinetic diffusion of radioactive phosphate. Both methods gave similar results with very significantly increased values after adrenaline $10^{-7}$ M treatment. Using various doses of adrenaline, the maximum effect was obtained with a concentration of $10^{-6}$ M. For identical adrenaline concentrations, the contact time (10 min or 30 min) had no significant effect on inulin space values. Adrenaline treatment had no influence on the total water of the tissue. Adrenergic blocking agents (propranolol and phentolamine) used separately induced partial inhibition of adrenaline activity. Total inhibition was obtained with a propanolol and phentolamine mixture. (Authors)

**13741.** Kutchai, Howard, and Johan B. Steen (Inst. of Physiology, Univ. of Oslo, Oslo, Norway). 1971. THE PERMEABILITY OF THE SWIMBLADDER. Comp. Biochem. Physiol., 39(1A): 119-123.

The $O_2$ and $CO_2$ permeability of the eel swimbladder is about one-tenth of values reported for connective tissue. The impermeability resides principally in the silvery outer layer of the swimbladder. The silvery layer contains many needle-shaped crystals. Guanine accounts for about 13 percent of the dry weight of the silvery layer. (Authors)

**13742.** Hoffert, J. Russell, Michael B. Fairbanks, and Paul O. Fromm (Dept. of Physiology, Mich. State Univ., East Lansing, Michigan). 1971. OCULAR OXYGEN CONCENTRATIONS ACCOMPANYING SEVERE CHRONIC OPHTHALMIC PATHOLOGY IN THE LAKE TROUT (Salvelinus namaycush). Comp. Biochem. Physiol., 39(1A): 137-145.

Ocular oxygen tensions of 359 $\pm$ 31.9 (37) mm Hg were found in normal lake trout eyes while those eyes showing gross pathology had a significantly lower $PO_2$ of 219 $\pm$ 34.4 (27). The progression of the ocular histopathology is described in relationship to pseudobranch degeneration. The maintenance of elevated intraocular $PO_2$ even in the presence of chronic ophthalmic pathology is noted. (Authors)

**13743.** Golovanenko, L. F. 1964. THE PHYSIOLOGICAL CONDITION OF THE YOUNG STURGEON REARED ON DIFFERENT FEEDS. (Fiziologicheskoe sostoyanie molodi osetra, vyrashchennoĭ na raznykh kormakh). From: Izvestiya Gosudarstvennogo Nauchno-issledovatel'skogo Instituta Ozernogo i Rechnogo Rybnogo Khozyaĭstva, Vol. 57, pp. 235-241. Translated by Robert M. Howland, Bureau of Sport Fisheries and Wildlife, Narragansett, R. I.

None of the investigated rations exerted any marked influence on the chemical composition of the body of the young sturgeon and on the hematological indices. According to the physiological indices investigated, the experimental groups of the sturgeon approximate the group raised in the pond with good food supply. All rations are full-value. Under the conditions of a deficit of live feeds a ration with the addition of 30% KRTF can be very useful. A high percentage of immature cells in the peripheral blood is normal for young-of-the-year sturgeons (40% on the average). Complete starvation for 7 days decreases erythropoiesis in the young sturgeons from 38 to 0-2% with a normally high content of hemoglobin in the blood. The first stage of anemia caused by an oligochaete diet is characterized by a lower than normal hemoglobin content in the blood (about 22%). Along with normal mature erythrocytes in the peripheral blood of anemic young sturgeons, pathologically changed basophilic cells and microerythrocytes are present. -- Robert M. Howland.

**13744.** FAO of the United Nations, Rome, Italy. 1970. FAO FISH CULTURE BULLETIN. A QUARTERLY NEWS DIGEST OF FISH CULTURE RESEARCH AND DEVELOPMENT. FAO Fish Cult. Bull., 2(4): 24 p., illus.

Text includes: From research institutions... Propagation of the grey mullet - Early spawning of channel catfish - Hybridization - Pond fertilization - Chlorella for rearing of marine fish larvae - Plastic "pastures" for grey mullets - Salmon nutrition - Weed control - Environmental manipulation - Control of competing species - Effect of herbicides on zooplankton - Cage culture of fish - Shrimp culture - Oyster culture - Low-cost water filter - Intensive carp culture in tanks. Fish culture development... Australia - Canada - Czechoslovakia - Germany, Eastern - Germany, Fed. Rep. of - Korea, Rep. of - Netherlands - New Zealand - Norway - Philippines - United States. Fish diseases and their control... IHN in salmon and trout - UDN in central Europe? - Crayfish parasite in Finland - Fish health control regulations - Fish disease laboratory - Swim bladder inflammation in common carp - Survival of VHS virus associated with trout eggs - Whirling disease of trout in Morocco - Parasite of Mediterranean eel - Infectious pancreatic necrosis of trout in Europe - New bacterial disease of tilapia. Introductions of fish, prawn and crayfish... Recent introductions - Introduced Tilapia species in Lake Naivasha - A new pond fish in South Africa - Grass carp in Indonesia - Salmon transplantation in the U. S. S. R. (From contents)

**13745.** FAO of the United Nations, Rome, Italy. 1971. FAO AQUACULTURE BULLETIN. A QUARTERLY NEWS DIGEST OF AQUACULTURE RESEARCH AND DEVELOPMENT. FAO Aquacult. Bull., 3(2): 24 p., illus.

Text includes: From research institutions... Propagation of the grey mullet - Selective breeding of channel catfish - Propagation of shrimps and prawns - Utilization of treated sewage for shellfish culture - Culture of Chinese carps and weed control - Culture of siganids - Polyculture of carps - Polyculture with Coregonus - Pompano culture - Lobster culture - Ultraviolet light for attracting aerial insects - Frog farming. Aquaculture development... Australia - China (Taiwan) - Cuba - Federal Republic of Germany - Greece - Iran - Israel - Ivory Coast - Japan - Malaysia - New Zealand - Philippines - Spain - Switzerland - United Kingdom - United States. Fish diseases and their control... Whirling disease - Terramycin for fish disease control - Furunculosis - Tapeworm in trout - Tail rot in young salmon - Diagnosis of IHN in salmon and trout - New fish disease laboratory in the United Kingdom - Fish sanitation programme in Hungary - Ceratomyxa in salmonids - Saprolegnia infection. Fish introductions... Ohrid trout in the United States - Chinese carps in Poland. (From contents)

**13746.** Gasimagomedov, A. A., and I. V. Issi (Dagestan Div. of the Caspian Scientific-Research Fish. Inst. (Makhachkala) and the All-Union Inst. for plant protection (Leningrad). 1970. MICROSPORIDIA - PARASITES OF FISHES OF THE CASPIAN SEA. (Mikrosporidii - Parazity Ryb Kaspiiskogo Morya). Zoologicheskiĭ Zhurnal, 49(8): 1117-1125, Moscow. Translated by Robert M. Howland, Bur. of Sport Fish. and Wildl., Narragansett, R. I.

As a result of complete parasitological analysis of fishes of the Caspian, wide distribution of Microsporidia has been established in 13 species of fish, and new species of these parasites have been revealed: Plistophora siluri sp. n. from the intestine of the European catfish, and P. tuberifera sp. n. from the subcutaneous layer of the musculature of the bighead goby, the Caspian round goby and Hyrcanian goby. Comparative analysis of the microsporidian Glugea luciopercae (Dogiel) from different hosts (pikeperch and Volga herring) showed that this is an aggregate species, on the basis of which two or three separate species can be segregated. -- Robert M. Howland.

**13747.** Ghittino, P. (Centro per lo Studio Delle Malattie dei Pesci Istituto Zooprofilattico Sperimentale del Piemonte e Della Liguria, Via Bologna, 148 - 10154, Torino, Italy). 1970. SANITARY REQUIREMENTS IN MODERN FISH FARMING. Riv. It. Piscic. Ittiopat., 5(4): 81-83.

**13748.** Ostroumova, I. N. 1964. CHANGE IN THE BLOOD OF THE RAINBOW TROUT WHEN FED WITH SPRAT. (Izmenenie Krovi Raduzhnoĭ Foreli pri Kormlenii ee Kil'Koĭ). From: Izvestiya Gosudarstvennogo Nauchno-issledovatel'skogo Instituta Ozernogo i Rechnogo Rybnogo Khozyaĭstva, Vol. 57, 261-266. Translated by Robert M. Howland, Bur. of Sport Fish. and Wildl., Narragansett, R. I.

Experiments were conducted with the inclusion of freshly frozen sprat in the trout ration. They were performed at the Central Experimental-Production Station of GosNIORKh "Ropsha" (from June through September, 1961). Appraisal of the efficiency and completeness of the feed was made according to piscicultural and physiological indices. Ration no. 9, which had 55% sprat in its composition, was reflected badly in the condition of two-summer fish (1+) and the "remount" (2+) rainbow trout. A general sluggishness in the movements of the fish, paleness of the gills, darkening of the integuments, a large amount of fat in the body cavity, and a sandy coloration of the liver were noted. Severe anemia developed: the quantity of hemoglobin and erythrocytes dropped sharply (on the average by 40-50% in comparison with the control); signs of disturbance of haemopoiesis were noted (anisocytosis, poikilocytosis, polychromatophilia). Ration no. 10, which contained 25% sprat, also had an unfavorable effect on the blood of two-summer trout, but to a lesser degree. The amount of hemoglobin decreased by 15-20% on the average. A number of individuals had signs of anemia. At the same time two-summer fish on ration no. 10 grew satisfactorily. In the "remount" held on this ration, no substantial deviations from the control were discovered. Ration no. 3, which contained spleen at 55% and no sprat, provided good results for a number of years. Appearing as the control for the experiments, it also caused no deviations from normal of the trout blood indices in this year. -- Robert M. Howland.

**13749.** Schwartz, Frank J. (Inst. of Mar. Sci., Univ. of No. Carolina, Morehead City, North Carolina). 1970. FISHES AND CHANGING ECOLOGY OF MULLET POND, A BARRIER BEACH ISLAND POND AT SHACKLEFORD BANKS, NORTH CAROLINA. J. Elisha Mitchell sci. Soc., 86(1): 31-34.

The changing ecology and fish species composition of Mullet Pond is reviewed. Since 1914 the number of fish species has declined from 26 to only four today. Mullet Pond is aging and dying, and its days are numbered. Present water areas encompass 150 x 15 feet. (Auth.)

**13750.** Merriner, J. V., W. T. Hogarth, and W. A. Foster (Dept. of Zool., No. Carolina State Univ., Raleigh, North Carolina). 1970. OCCURRENCE OF THE COMMON SNOOK, Centropomus undecimalis (Bloch) (PISCES - CENTROPOMIDAE), IN NORTH CAROLINA WATERS. J. Elisha Mitchell sci. Soc., 86(4): 194-195.

Two spatially and temporally distinct captures of juvenile Centropomus undecimalis, the common snook, from Bogue Sound (two specimens - 1966) and Pamlico Sound (three specimens - 1969), North Carolina are reported. Snook are considered voluntary immigrants or water current transports to our waters and not progeny from a local spawning population, since winter water temperatures below 40°F are common and the stated minimum safe survival temperature is 60°F for Florida snook. Further studies of the distribution and seasonal appearance of snook are under way. (Authors)

**13751.** Legge, Thomas N. (Dept. of Biol., Edinboro State College, Edinboro, Pennsylvania). 1971. Dactylogyrus carolinensis sp. n., A MONOGENETIC TREMATODE FROM THE WHITE SHINER. J. Elisha Mitchell sci. Soc., 87(1): 36-38.

A new species of monogenetic trematode, Dactylogyrus carolinensis, from the gills of the white shiner, Notropis albeolus Jordan, is described. It is characterized by a copulatory complex consisting of a fine, curved cirrus tube and a branched accessory piece with the main shaft terminating in a club. The new species was found on 71 percent of the White Shiners examined from Wake Co., North Carolina. (Auth.)

13752. Yoshida, Yoichi (Dept. Fish., Fac. Agr., Kyoto Univ., Maizuru, Japan). 1970. STUDIES ON THE EFFICIENCY OF FOOD CONVERSION TO FISH BODY GROWTH - V. VALUES OF $\gamma$, $\beta$ AND $\beta'$ OF THE FISHES IN FIELD. Bull. Jap. Soc. sci. Fish., 36(10): 1017-1020.

Attempts were made to estimate the values of $\gamma$ and $\beta$ of fishes in field, using the data described in the papers which have been published on the growth of fish by many investigators. As results of the attempts, it was noted that the values of $\gamma$ and $\beta$ of oceanic or active fishes are comparatively high, as compared with those of benthic or inactive fishes, and the fishes of high trophic levels are comparatively low in the values of $\gamma$ and comparatively high in those of $\beta$, as compared with those of the fishes of low trophic levels. The values of $\beta$ and $\beta/\beta'$ of Seriola quinqueradiata in the field were estimated, based on Mitani's data, and these values of the fishes in the field are further discussed. (Auth.)

13753. Hidaka, Iwao (Fac. of Fish., Mie Prefectural Univ., Tsu, Mie Prefecture, Japan). 1970. THE EFFECT OF CARBON DIOXIDE ON THE CARP PALATAL CHEMORECEPTORS. Bull. Jap. Soc. sci. Fish., 36(10): 1034-1039.

The stimulatory effect of carbon dioxide dissolved in water upon carp palatal chemoreceptors was studied by recording the electrical responses from the palatine nerve supplying the chemoreceptors. Taste units responsive to carbon dioxide in water were found. These units responded also to one or more of the four conventional taste stimuli used. Among them were units which responded well to carbon dioxide in water but not to hydrochloric acid. No marked correlations could be detected between carbon dioxide and the other stimuli in their stimulating effectiveness for these taste units. The effects of carbon dioxide in phosphate buffer, in disodium hydrogen phosphate and sodium bicarbonate solutions also were studied. From the results with these mixtures, it could be suggested that carbon dioxide itself is responsible for receptor stimulation. It appeared also that the anion is important in stimulation by salts of carp chemoreceptors other than those specifically responsive to dilute electrolyte solutions. (Auth.)

13754. Numachi, Ken-ichi (Ocean Res. Inst., Univ. of Tokyo, Nakano, Tokyo). 1970. LACTATE AND MALATE DEHYDROGENASE ISOZYME PATTERNS IN FISH AND MARINE MAMMALS. Bull. Jap. Soc. sci. Fish., 36(10): 1067-1077.

Crude extracts from skeletal muscle of thirty-nine species of fish showed a considerable species variation of LDH and MDH isozymes in number and electrophoretic mobilities. It was a marked contrast to the similarity of the LDH isozyme patterns in the marine mammals studied and in terrestrial mammals. However, closely related species showed similar isozyme patterns, or contained some very similar isozymes of LDH and MDH. The electrophoretic patterns of LDH and MDH contained in skeletal muscle of fish species were complex, to be attributed to the polymers formed by random association of two subunits under the control of two genes. The genetic basis and physiological meaning for the isozymes are discussed with reference to the results of recent investigations. (Auth.)

13755. Nishiyama, Tsuneo (Fac. of Fish., Hokkaido Univ., Hakodate, Japan). 1970. CALORIC VALUES OF OVARIES OF SOCKEYE SALMON AT LAST STAGE OF MARINE LIFE. Bull. Jap. Soc. sci. Fish., 36(11): 1095-1100.

Caloric values were determined for Bristol Bay sockeye salmon ovaries ranging from 35 g to 282 g in wet weight. The values differed from 7, 100 cal to 6, 600 cal per gram dry weight, depending on ovary weight. There was a tendency for caloric values to decrease gradually as the ovary weight increased. This relationship was also maintained in the maturity index, or diameter of eggs. The total caloric content of ovaries of individual fish is associated with ovary weight, diameter of eggs or maturity index. This can be expressed by linear regression with high correlation coefficients. (Auth. summ.)

13756. Hirata, Miyoshi, Sumiro Isoda, Munefumi Kanao, Hiroya Shimizu, and Shin-ichi Inoue (Res. Labs., Daiichi Seiyaku Co., Ltd., Edogawa-ku, Tokyo, Japan). 1970. STUDIES ON ANESTHETICS FOR FISH. Bull. Jap. Soc. sci. Fish., 36(11): 1127-1135.

Ninety-two anthranilate derivatives were synthesized and examined for the

anesthetic effect of these compounds on goldfish and puffer. From these results, it is clear that compound No. 36, DP-1166, is the most potent anesthetic for fish and this compound also showed an excellent effectiveness on other kinds of fish. (Authors summ.)

13757. Ogino, Chinkichi, Nagahisa Uki, Takeshi Watanabe, Zenzo Iida, and Kazuo Ando (Tokyo Univ. of Fish., Konan-4, Minato-ku, Tokyo). 1970. B VITAMIN REQUIREMENTS OF CARP - IV. REQUIREMENT FOR CHOLINE. Bull. Jap. Soc. sci. Fish., 36(11): 1140-1146.

The requirement and deficiency symptoms of young carp for choline have been studied. Carp fed a diet low in choline accumulated a large quantity of neutral fat in the hepatic tissue. This abnormality corresponded to fatty liver of mammals in chemical and histological conclusions. Amount of choline chloride needed for prevention from fatty liver of young carp was 60-120 mg per kg of body weight per day under the experimental conditions adopted. (Authors summ.)

13758. Kubota, Minoru, and Akihiko Ohnuma (Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo). 1970. STUDIES ON BONITO PEPSIN - I. PURIFICATION OF PEPSIN. Bull. Jap. Soc. sci. Fish., 36(11): 1147-1151.

The gastric proteases of fishes have been studied in detail regarding enzyme properties. In the present paper, the purification method of bonito pepsin was studied as a first step in the investigations to explain the enzymic characteristics of gastric proteases. When the extraction methods of pepsin from gastric mucosa of bonito were tested by using distilled water, acid solution (0.05 N HCl, pH 2.0), alkaline solution (0.4 M Na-acetate-0.4 M Na-carbonate, pH 8.1) and 25% acetone water solution, distilled water extraction proved to give the best yield. The pepsin purified by the modified method of Norris and Mathies (1953) had the specific activity of 0.198 $(PU)^{Hb}_{mg\,PN}$ which was 68 times as much as the original crude extract. From results of electrophoresis on starch gel (pH 3.2, 0.05 M citrate buffer), it was ascertained that the hog crystallized pepsin showed only a spot migrating toward the anode. However, pepsin and the protease extracted from the gastric content of bonito showed two spots which migrated toward the cathode and were situated at approximately the same position. The bonito pepsin apparently differed from the hog crystallized pepsin in its electrophoretic behaviour. (Authors)

13759. Kubota, Minoru, and Akihiko Ohnuma (Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo, Japan). 1970. STUDIES ON BONITO PEPSIN - II. ENZYMIC PROPERTIES OF BONITO PEPSIN. Bull. Jap. Soc. sci. Fish., 36(11): 1152-1156.

In the present paper, some enzymic properties of the bonito pepsin, purified by ammonium sulfate fractionation as described in the previous paper, were determined by comparison with the crystalline hog pepsin. The results obtained are as follows: Effect of pH on PU (proteolytic activity). The optimum pH values of bonito pepsin were near 2 for the substrate of milk casein and hemoglobin and another optimum value was observed at near 3.6. Hog pepsin had optimum pH values of 1.6 for casein and 2.0 for hemoglobin. Effect of substrate concentration on PU. Bonito and hog pepsins showed maximum activity in hemoglobin concentrations of 1.5-2.5%, and 0.7% (W/V), respectively. Effect of reaction temperature on PU. These optimum temperatures for bonito and hog pepsins were 35°C and 45°C, respectively. Stability. Considerable differences regarding thermal stability were not observed for both pepsins, but in a neutral solution hog pepsin was rather less stable than the bonito pepsin. Substrate specificity. Pepsins of both bonito and hog exhibited proteolytic action on hemoglobin, but the former pepsin was less active than the latter for the synthetic substrate (N-acetyl-l-phenylalanyl-l-diiodotyrosine). Species specificity between the pepsins of bonito and hog can be detected in some enzymic properties. (Authors)

13760. Oshima, Yasuo, Yasuaki Osada, Mieko Akagawa, and Nobuhiko Nakazawa (Biol. Lab. of Res. Labs., Daiich Seiyaku Co., Ltd., Edogawa-ku, Tokyo, Japan). 1970. CHEMOTHERAPEUTICAL STUDIES ON POTASSIUM -1-METHYL-1, 4-

DIHYDRO-7-[2-(5-NITRO-2-FURYL)-VINYL]-4-OXO-1, 8-NAPHTHYRIDINE-3-CARBOXYLIC ACID AGAINST INFECTIOUS DISEASES IN FISH. Bull. Jap. Soc. sci. Fish., 36(11): 1186-1199.

The authors investigated the potencies of some chemotherapeutics against infectious diseases in fish as observed in some breeding farms for marine or fresh water fish. Potassium-1-methyl-1, 4-dihydro-7-[2-(5-nitro-2-furyl)-vinyl]-4-oxo-1, 8-naphthyridine-3-carboxylic acid (DS-677 K) showed excellent in vitro bactericidal effects against fish pathogens which cause some types of serious diseases in fish. Furthermore, the antibacterial activity of this agent did not change with temperature. However, its activity was reduced rapidly by sunlight. Though tissue levels of this compound were low, chemotherapeutical effects in eel and goldfish, infected with A. liquefaciens, were higher than those of DF or TC which were used as control drugs. (Authors)

**13761.** Buzakova, A. M. (Inst. of Hydrobiology, Dnepropetrovsk State Univ., USSR). 1969. PLANKTOBENTHIC CRUSTACEANS FROM THE DNEPR RESERVOIR (LAKE LENIN) AS FISH FOOD. Hydrobiological Journal, published by Amer. Fish. Soc., 5(6): 51-55.

Long-term and seasonal data are given on the composition and quantitative dynamics of lower crustaceans from the water layers near the bottom in Dnepr Reservoir (Lake Lenin). Their role as food for fish is indicated. (Auth.)

**13762.** Sabodash, V. M. (Inst. of Hydrobiol., Acad. of Sci., Ukrainian SSR, Kiev, USSR). 1969. ZINC CONTENT IN RIPE SEX PRODUCTS OF THE CARP. Hydrobiological Journal, published by Amer. Fish. Soc., 5(6): 65-69.

A study of the dynamics of the zinc content in the sex glands of the carp as related to individual differences and the age of the fish has shown that highest concentrations of this element occur in the oocytes and sperm of three-year-old fish spawning for the first time. The content declined sharply in four- and five-year-old fish, remaining at the same level in fish up to 14 years old, regardless of season. Variations in this index within a single age group depended apparently on feeding conditions in different years.

**13763.** Arsan, O. M., and A. Ya. Malyarevskaya (Inst. of Hydrobiol., Acad. of Sci., Ukrainian SSR, Kiev, USSR). 1969. THE EFFECT OF FOOD ON THIAMINASE ACTIVITY AND THE CONTENT OF THIAMINE IN THE LIVER AND INTESTINE OF SILVER CARP. Hydrobiological Journal, published by Amer. Fish. Soc., 5(6): 79-81.

The data on the thiamine content in the liver and gut of silver carp fed different kinds of food indicate that it was lowest in individuals which had eaten blue-green algae (up to 1.9 micrograms in the liver), rising to a higher level when the food was green algae, and rising even higher in the experiments with mixed food, protococcal algae, and daphnia. The thiamine content was highest in the liver of the fasting silver carp. The same pattern was observed in the gut of the silver carp. Thus thiaminase activity and thiamine content in the liver and intestine of silver carp depend on the food consumed by them. Increasing thiaminase activity in the food consumed is accompanied by a corresponding increase in the liver and the intestines of the fish, reaching maximum values in individuals which have been fed blue-green algae. The thiamine content increases in those cases where the fish have been fed a food with a lower thiaminase activity.

**13764.** Somkina, N. V. (State Univ. at Rostov-on-Don, USSR). 1969. PEPTIDES IN THE BRAIN OF FISHES. Hydrobiological Journal, published by Amer. Fish. Soc., 5(6): 81-83.

In the course of phylogenetic development, the histidine-containing peptide appears in the brain of bony ganoids; its concentration is maximum in the brain of the bony fishes and decreases in the animals with a terrestrial mode of life. This same peptide is a specific compound necessary for normal activity of the brain of poikilothermic animals. Its content is in direct relationship to the level of evolutionary development of the latter.

**13765.** Loskutova, G. F., and V. P. Solovov (Altay Scientific Res. Inst. of Agr., Barnaul, USSR). 1969. THE FOOD AND FEEDING OF THE PELED [Coregonus peled (Gmelin)] IN LAKE DOLGOYE (ALTAYSKIY KRAY). Hydrobiological Journal, published by Amer. Fish. Soc., 5(6): 83-86.

The content of the food of the peled in Lake Dolgoye depends entirely on the composition and density of the aquatic organisms in particular seasons of the year. This also emphasizes its high food flexibility. On the basis of our data concerning the feeding of the peled in Lake Dolgoye it is impossible to agree with the opinion of V. N. Abrosov that a summer biomass of zooplankton at 1-2 $g/m^3$ is a limit above which the natural food of the fish is zooplankton, nor with the view that the fish necessarily turned to feeding on benthos, particularly gammarids, and that this reduces the growth rate and leads to the development of a dwarf form. In our experiments the maximum daily weight increment in the peled occurred precisely in the period when it was feeding on the gammarids. In Lake Dolgoye, as in Lake Aay (Vilyuy River Basin), the peled shows a clear selective preference for larger food objects. The feeding rate of the fish declines during the summer when the water temperature rises above 26°C, but the summer temperature maximum in Lake Dolgoye of up to 30.8°C did not lead to the death of the fingerlings, and we did not find individuals with empty stomachs. The peled feed most rapidly in September, a phenomenon associated with the cooling of the water and with the maximum growth of gammarids during this period. Total indices of stomach fullness were: in August up to 14.5 °/ooo, in September up to 168.8 °/ooo, and in October up to 137.9 °/ooo.

**13766.** Hanek, George, and C. H. Fernando (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1971. Pseudomazocraeoides ontariensis n. sp. (MONOGENOIDEA: MAZOCRAEIDAE) FROM Dorosoma cepedianum (LeSueur) IN BAY OF QUINTE, ONTARIO. Canad. J. Zool., 49(4): 573-575.

Pseudomazocraeoides ontariensis n. sp. is described and figured from Dorosoma cepedianum (LeSueur) caught in the Bay of Quinte, Ontario, Canada. This is the first record of a species of Mazocraeidae from Canada. (Authors)

**13767.** Bache, C. A., W. A. Gutenmann, and D. J. Lisk (Pesticide Residue Lab., Dept. of Entomol., Cornell Univ., Ithaca, New York). 1971. RESIDUES OF TOTAL MERCURY AND METHYLMERCURIC SALTS IN LAKE TROUT AS A FUNCTION OF AGE. Science, 172(3986): 951-952.

An analysis of the concentrations of total mercury and methylmercuric salts in lake trout of precisely known ages from 1 to 12 years has been carried out. The concentrations of both total mercury and methylmercury increased with the age of the fish. The proportion of methylmercury to total mercury also increased with age. (Authors)

**13768.** Brett, John R. (Fish. Res. Bd. Canada Biol. Sta., Nanaimo, British Columbia, Canada). 1971. ENERGETIC RESPONSES OF SALMON TO TEMPERATURE. A STUDY OF SOME THERMAL RELATIONS IN THE PHYSIOLOGY AND FRESHWATER ECOLOGY OF SOCKEYE SALMON (Oncorhynchus nerka). Am. Zoologist, 11(1): 99-113.

Studies on the relation of temperature to tolerance, preference, metabolic rate, performance, circulation, and growth of sockeye salmon all point to a physiological optimum in the region of 15°C. Natural occurrence is limited in time and space at temperatures above 18°C despite being able to tolerate 24°C. Forms of physiological inadequacy can be demonstrated which account for such restrictions in distribution. Predictive power for locating and accounting for concentrations of young fish in thermally stratified lakes appeared to provide "proof" for the controlling influence of the physiological optimum temperature. Early literature on the ecology of sockeye supported this view. Recent studies using midwater trawls and sonar detection reveal a diurnal behavior pattern which points to a more subtle interaction of biotic and abiotic factors governing vertical distribution in which the controlling force appears to be bioenergetic efficiency. It is concluded that a mechanism of behavioral thermoregulation has evolved which favorably balances daily metabolic expenditures in order to conserve energy when food is limited. (Auth. synopsis)

13769. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife (Washington, D. C.). 1971. SPORT FISHING USA. Bur. Sport Fisheries and Wildlife, USDI, for sale by Supt. of Documents, U. S. Govt. Printing Office, Wash., D. C. 20402, price $10.00.

Text includes: A question everyone asks... Why people fish. The fish... Outside and in - Zip code $H_2O$ - Food for fish - Migrations - One generation after another - Understanding fish behavior - By any other name. The fisherman... Who fishes - Tools of the trade - Tricks of the trade - The right time - Any fish is a good catch - Escape to reality - Try the unusual - A memorable day - Their names are writ on water - Fish are fascinating - Lip-smacking goodness. The right place... Somewhere a river begins - Downstream - Big reservoirs - Tailwaters - Natural lakes - Farm ponds - Estuaries - Along the coast - Out to sea. Man tries his hand... Genesis - Fishery science - Man-made fish - Old fish in new homes - A new look at hatcheries. Money to be made... Benefits spread far and wide - Cash and carry fishing - The bait industry. Problems to overcome... The threat of technology - A fish looks at multiple use - Frustrations - Aim for quality. The future... Good, bad, or indifferent? (From contents)

13770. Carey, Francis G., John M. Teal, John W. Kanwisher, Kenneth D. Lawson, and James S. Beckett (Woods Hole Oceanog. Inst., Woods Hole, Massachusetts). 1971. WARM-BODIED FISH. Am. Zoologist, 11(1): 137-145.

Two groups of fishes, the tuna and the lamnid sharks, have evolved countercurrent heat-exchange mechanisms for conserving metabolic heat and raising their body temperatures. Warm muscle can produce more power, and considering the other adaptations for fast swimming in these fish, it seems likely that the selective advantages of greater speed made possible by the warm muscle were important in the evolution of this system. Some tunas such as the yellowfin and skipjack are at a fixed temperature difference above the water, but bluefin tuna can thermoregulate. Telemetry experiments show that the bluefin tuna can maintain a constant deep body temperature during marked changes in the temperature of its environment. (Authors synopsis)

13771. Somero, George N., and Peter W. Hochachka (Dept. of Zool., Univ. of Brit. Columbia, Vancouver 8, Canada). 1971. BIOCHEMICAL ADAPTATION TO THE ENVIRONMENT. Am. Zoologist, 11(1): 159-167.

Biochemical adaptation to environmental parameters such as temperature appears to involve two distinct types of changes in the organism's chemistry. On the one hand, the quantities of certain molecular species present in the cells may change. Alternatively, the actual types of molecules present may vary. Rainbow trout (Salmo gairdneri) acclimated to warm and cold temperatures exhibit a striking example of this latter type of adaptation. For all enzymes we have examined in this species, distinct "warm" and "cold" isozymes are present. The isozymes found in warm-acclimated (18°C) trout function well only at temperatures above 10-12°C. The isozymes present in cold-acclimated (4°C) trout function optimally at 2-5°C, temperatures this species normally encounters in winter. These data, plus information on comparable changes in membrane lipids, lead us to propose that adult poikilotherms may undergo a considerable degree of "biochemical restructuring" on a seasonal basis. The factors which control this "restructuring", and the rates at which the process occurs at high and low temperatures, are topics for future investigation. (Authors synopsis)

13772. Hoff, Frank H., Jr. 1970. ARTIFICIAL SPAWNING OF BLACK SEA BASS, Centropistes striatus melanus Ginsburg, AIDED BY CHORIONIC GONADOTROPHIC HORMONES. Florida Dept. of Nat. Resources, Marine Research Lab., St. Petersburg, Florida, Special Scientific Report No. 25, 17 p.

The effects of chorionic gonadotrophic hormones were tested on the ripening and spawning of black seabass. Centropistes striatus melanus was selected because it is a vigorous, fast growing species with definite commercial potential. Dosage levels required, time interval between injection and ripeness, and methods of handling and rearing larvae were also investigated. The interval between injection (at 700 IU per pound) and ripeness averaged 54 hours. Eggs hatched 38 hours after fertilization and larvae were maintained for 134 hours. (Auth.)

**13773.** Bahr, Thomas G., and Robert C. Ball (Inst. of Water Research, Mich. State Univ., East Lansing, Michigan). 1971. ACTION OF DDT ON EVOKED AND SPONTANEOUS ACTIVITY FROM THE RAINBOW TROUT LATERAL LINE NERVE. Comp. Biochem. Physiol., 38(2A): 279-284.

Spontaneous and evoked neural activity was recorded from multifiber lateral line nerve preparations of rainbow trout, Salmo gairdneri. DDT was administered to fish in water and by intravenous injection. DDT-treated fish demonstrated classical poisoning symptoms in the absence of abnormal lateral line nerve discharge. Results indicate that the frequency of spontaneous activity from the lateral line nerve does not provide a sensitive index for analyzing the neurotoxic action of DDT, and afferent activity from this nerve appears to play a minor role in acute poisoning symptoms. (Authors)

**13774.** Eckstein, Benjamin, and Yair Katz (Dept. of Zool., Hebrew Univ. of Jerusalem, Israel). 1971. STEROIDOGENESIS IN POST- AND PRE-SPAWNED OVARIES OF A CICHLID FISH, Tilapia aurea. Comp. Biochem. Physiol., 38(2A): 329-338.

From ovarian minces of pre- and post-spawned Tilapia aurea incubated with pregnenolone-7$\alpha$-$^{3}$H, thirteen radioactive peaks were isolated. Six radiometabolites were identified by their mobilities on thin-layer and column chromatography, derivative formation and in some instances by recrystallization to constant specific activity. The metabolites identified were: progesterone, androstenedione, dehydroepiandrosterone, testosterone, 11-ketotestosterone and 11$\beta$-hydroxytestosterone. The pre-spawned ovaries produced 2-5 times more testosterone than the ovaries of post-spawned fish. In the ovarian incubates at both reproductive states, more than 60 percent of the total radioactivity was converted into three androgens: testosterone, 11-ketotestosterone and 11$\beta$-hydroxytestosterone. It is the first time that 11$\beta$-hydroxytestosterone has been identified in ovarian tissue of any animal. (Authors)

**13775.** Holstein, B. (Dept. of Zoophysiology, Univ. of Göteborg, Göteborg, Sweden). 1971. METABOLISM OF INTRAPERITONEALLY INJECTED $^{14}$C-HISTAMINE IN THE YELLOW EEL (Anguilla anguilla). Comp. Biochem. Physiol., 38(2A): 435-441.

Total radioactivity, $^{14}$C-histamine and $^{14}$C-methylhistamine were assayed in PCA-extracts of tissues of eel, and of whole eel injected with $^{14}$C-histamine. DAO-activity was assayed in vitro. In untreated animals, 22 percent of injected radioactivity persisted after 24 hr; at that time, $^{14}$C-histamine and $^{14}$C-methylhistamine were 1 percent and 0.2 percent of the injected dose, respectively. After aminoguanidine treatment the recovery of $^{14}$C-histamine after 7.5 hr was doubled, the $^{14}$C-methylhistamine fraction increased about 2.5 times. The combined treatment with aminoguanidine and iproniazid further raised the $^{14}$C-histamine recovery but did not affect $^{14}$C-methylhistamine. Liver and kidney were most efficient in extracting radioactivity. It is concluded that oxidative and methylating pathways are the most important ways to metabolize histamine in this species. (Auth.)

**13776.** Utida, Seiitiro, Mie Kamiya, and Nobuko Shirai (Lab. of Physiology, Ocean Res. Inst., Univ. of Tokyo, Nakano Tokyo, Japan). 1971. RELATIONSHIP BETWEEN THE ACTIVITY OF Na+-K+-ACTIVATED ADENOSINETRIPHOSPHATASE AND THE NUMBER OF CHLORIDE CELLS IN EEL GILLS WITH SPECIAL REFERENCE TO SEA-WATER ADAPTATION. Comp. Biochem. Physiol., 38(2A): 443-447.

Na+-K+ ATPase activity and the number of chloride cells of gills increased five- to six-fold during the first week after transferring the eels from fresh water to sea water and decreased to the fresh-water level within 4 weeks after returning to fresh water. When the eels were adapted to media of various salinities, both the enzyme activity and the number of chloride cells increased in proportion to the increase of external salinity. The Na+-K+ ATPase of the gill seems to be localized mainly in the chloride cell and to be involved in the salt excretion of eels in sea water. (Authors)

13777. Massaro, Edward J., and Henry E. Booke (Dept. of Biochem., State Univ. of New York at Buffalo, Buffalo, New York). 1971. PHOTOREGULATION OF THE EXPRESSION OF LACTATE DEHYDROGENASE ISOZYMES IN Fundulus heteroclitus (Linnaeus). Comp. Biochem. Physiol., 38(2B): 327-332.

Fundulus heteroclitus possesses two codominant alleles, B and B', coding for the B-type subunits of lactate dehydrogenase (LDH) isozymes and normally expresses three LDH phenotypes, BB, BB', and B'B'. In dark-adapted animals the B-locus polymorphism disappears and all individuals express identical LDH isozyme patterns. Apparently, lack of photo-stimulation simultaneously represses the B-locus and depresses other loci coding for immunologically related, but electrophoretically dissimilar subunits. (Authors)

13778. Mehrle, Paul M., David L. Stalling, and Richard A. Bloomfield (Fish-Pesticide Res. Lab., Bur. of Sport Fish. and Wildl., Columbia, Missouri). 1971. SERUM AMINO ACIDS IN RAINBOW TROUT (Salmo gairdneri) AS AFFECTED BY DDT AND DIELDRIN. Comp. Biochem. Physiol., 38(2B): 373-377.

Serum amino acid concentrations of rainbow trout (Salmo gairdneri) were determined by gas-liquid chromatography. Total serum amino acid concentrations were significantly increased by chronic exposures of DDT and dieldrin administered in the diet for 140 days. DDT altered the concentrations of 9 amino acids, and dieldrin altered the concentrations of 11. In untreated fish subjected to forced swimming for 6 hr and 24 hr, concentrations of all amino acids decreased except for arginine and alanine. There was a significant interaction between pesticide treatment and forced swimming in regard to total serum amino acid concentration, and the concentrations of 11 amino acids. (Authors)

13779. Peterson, Gary L., and Ziad H. Shehadeh (The Oceanic Inst., Makapuu Oceanic Center, Waimanalo, Hawaii). 1971. CHANGES IN BLOOD COMPONENTS OF THE MULLET, Mugil cephalus L., FOLLOWING TREATMENT WITH SALMON GONADOTROPIN AND METHYLTESTOSTERONE. Comp. Biochem. Physiol., 38(2B): 451-457.

Blood from twenty-six striped mullet (Mugil cephalus) injected with salmon gonadotropin and methyltestosterone was compared to blood from saline injected controls for changes in hematocrit, total dissolved plasma solids, plasma osmolarity, total plasma calcium and copper, and electrophoretic patterns of plasma proteins. In all hormone treated fish, hematocrits increased slightly, plasma solids increased significantly ($P \leq 0.05$) and osmolarity was not affected. Total plasma calcium increased with the higher (5.0 mg) gonadotropin dose, and increased markedly in methyltestosterone treated fish. Plasma copper changes followed those of calcium but were not pronounced. Methyltestosterone, in contrast to salmon gonadotropin, induced distinct qualitative and quantitative changes in plasma protein electropherograms. (Authors)

13780. Sonneborn, David W., and Hans J. Hansen (Dept. of Biochem. Nutrition, Hoffman-LaRoche Res. Lab., Nutley, New Jersey). 1971. THE VITAMIN $B_{12}$-BINDING PROTEINS OF HOLOSTIAN FISH. Comp. Biochem. Physiol., 38(2B): 467-470.

The gar and the bowfin possess unsaturated vitamin $B_{12}$-binding proteins in their sera and stomachs. The binder in gar stomach (mol. wt. = 50,000) is twice the size of the gar serum binder (mol. wt. = 25,000). The bowfin stomach and serum binders are the same size (mol. wt. = 35,000). (Authors)

13781. Gibson, James R., and J. Larry Ludke (Dept. of Zool., Mississippi State Univ., State College, Mississippi). 1971. EFFECT OF SESAMEX ON BRAIN ACETYL CHOLINESTERASE INHIBITION BY PARATHION IN FISHES. Bull. Environmental Contamination and Toxicology, 6(2): 97-99.

Experiments indicate that the degree of brain ACLE inhibition resulting from exposure to parathion is decreased by pretreatment with sesamex. Presumably the decrease is mediated - as in other species - through inhibition of the activating enzyme. (Authors conclusions)

**13782.** Graham, Charles R., Jr., F. Lawrence Dewberry, and Henry F. Edelhauser (Dept. of Biol., Loyola Coll., Baltimore, Maryland). 1971. ION FLUXES ACROSS NORMAL AND DIAMOX-TREATED BROOK TROUT GAS BLADDERS. Comp. Biochem. Physiol., 38(3A): 489-496.

Bicarbonate ions are actively transported in a serosal-to-mucosal direction across the Brook trout gas bladder. Potassium and hydrogen ions also play important roles in the maintenance of electrostatic and osmotic gradients across the bladder wall. Hydrogen ions are transported into the mucosal bathing fluid by neutral binding to bicarbonate ions. Mucosal acidification is eliminated by removing bicarbonate from the bathing medium. Diamox does not significantly alter the transport of bicarbonate or hydrogen ions but decreases the permeability of the bladder to chloride and potassium ions in the serosal-to-mucosal direction. (Authors)

**13783.** Cardwell, Rick D., James B. Saddler, and Lynwood S. Smith (Fish. Res. Inst., College of Fisheries, Univ. of Wash., Seattle, Washington). 1971. HEMATOLOGICAL EFFECTS OF DENNISON TAGGING UPON JUVENILE PINK SALMON (Oncorhynchus gorbuscha). Comp. Biochem. Physiol., 38(3A): 497-508.

Wild, marine-dwelling, juvenile pink salmon were captured and tagged. Blood samples were taken during a 6-1/2-day period. There were no significant hematological differences between tagged and untagged fish. Temporal variations in PCV were not significant in either test group. Significant reductions in TDS and TPP occurred in tagged salmon. There were substantial changes in the electrophoretic composition of the plasma proteins of both groups, notably a reduction in albumin concentration and an increase in $\beta$-globulins. (Authors)

**13784.** Cameron, James N. (Dept. of Zool., Univ. of Br. Columbia, Vancouver, British Columbia, Canada). 1971. OXYGEN DISSOCIATION CHARACTERISTICS OF THE BLOOD OF THE RAINBOW TROUT, Salmo gairdneri. Comp. Biochem. Physiol., 38(3A): 699-704.

The oxygen dissociation curves of whole blood were determined for the rainbow trout at 10, 15, and 20°C, and at partial pressures of 0, 3 and 7-8 mm Hg $CO_2$. Venous oxygen content measurements were made on a few fish to confirm the applicability of the conditions used. The $P_{50}$ values for rainbow trout range from 9 to 38 mm Hg $O_2$, depending on temperature and carbon dioxide tension. Root effect was judged to be negligible (less than 5 percent) at a $CO_2$ tension of 3 mm Hg. The dissociation curve determined for a group of fish acclimated to 18°C was not significantly different from the others acclimated to 7-9°C. Venous oxygen saturation was generally in the range of 50-65%. (Auth.)

**13785.** Saunders, Lloyd H., and Joseph A. McKenzie (Dept. of Biol., Univ. of New Brunswick, Fredericton, New Brunswick, Canada). 1971. COMPARATIVE ELECTROPHORESIS OF ARCTIC CHAR. Comp. Biochem. Physiol., 38(3B): 487-492.

Electropheretic patterns of five protein groups from seven geographically isolated populations of Salvelinus alpinus were compared. Muscle protein patterns of S. alpinus, S. aureolus and S. oquassa revealed no interspecific variations. Eye lens proteins, liver LDH and liver esterase demonstrated interpopulation variations which may be useful as population markers. A liver esterase polymorphism was found within the population from Matamek Lake, Quebec. (Authors)

**13786.** Legler, D. W., P. F. Weinheimer, R. T. Acton, H. K. Dupree, and T. R. Russell (Dept. of Microbiol., Univ. of Ala. Med. Center, Birmingham, Alabama). 1971. HUMORAL IMMUNE FACTORS IN THE PADDLEFISH, Polyodon spathula. Comp. Biochem. Physiol., 38(3B): 523-527.

Natural agglutinin titers to Salmonella typhosa "O" (STO), human group A erythrocytes (HuA) and sheep erythrocytes (SRBC) were studied in twenty-three paddlefish. Natural agglutinin titers to SRBC were low, with high titers observed to STO and HuA. Cold agglutinin titers (4°C) to STO markedly exceeded titers recorded at room temperature. Serum immunoglobulins were shown to account for over forty percent of the total serum proteins in this species. (Authors)

13787. Huggins, A. K., and L. Colley (Dept. of Biochem., Univ. Coll. London, Gower Street, London WC1E 6BT, England). 1971. THE CHANGES IN THE NON-PROTEIN NITROGENOUS CONSTITUENTS OF MUSCLE DURING THE ADAPTATION OF THE EEL Anguilla anguilla L. FROM FRESH WATER TO SEA WATER. Comp. Biochem. Physiol., 38(3B): 537-541.

The levels of the following muscle constituents were measured in eels adapted to either fresh water or to sea water: Na, K, tissue water, total ninhydrin-positive material, individual free amino acids, ethanolamine, cystathionine and carnosine. A significant increase in the total free amino acids occurred on adaptation of the eels to sea water. This increase could be accounted for by changes in alanine, glutamine, glutamic acid, glycine, proline, tyrosine and cystathionine, whereas carnosine, ethanolamine and the remaining amino acids did not alter appreciably. (Authors)

13788. Gillen, Robert G., and Austen Riggs (Dept. of Zool., The Univ. of Texas at Austin, Austin, Texas). 1971. THE HEMOGLOBINS OF A FRESH-WATER TELEOST, Cichlasoma cyanoguttatum (Baird and Girard) - I. THE EFFECTS OF PHOSPHORYLATED ORGANIC COMPOUNDS UPON THE OXYGEN EQUILIBRIA. Comp. Biochem. Physiol., 38(3B): 585-595.

Adenosine triphosphate (ATP) was found to be the major phosphorylated organic compound in the red cells of the teleost, Cichlasoma cyanoguttatum. Addition of ATP to phosphate-free solutions of hemoglobin decreases the oxygen affinity, increases the Bohr effect and modifies heme-heme interaction. The effects of DPG and ADP are similar but much smaller than the effect of ATP; cyclic AMP has no effect. (Authors)

13789. Mann, R. H. K. (Freshwater Biol. Assoc., The River Lab., East Stoke, Wareham, Dorset, England). 1971. THE POPULATIONS, GROWTH AND PRODUCTION OF FISH IN FOUR SMALL STREAMS IN SOUTHERN ENGLAND. J. Anim. Ecol., 40(1): 155-190.

Survival, growth and annual production of six species of fish were measured in one soft water and five hard water stream sites in southern England, the species studied being trout (Salmo trutta), salmon parr (S. salar), bullhead (Cottus gobio), stone-loach (Nemacheilus barbatula), three spined stickleback (Gasterosteus aculeatus) and minnow (Phoxinus phoxinus). There were only minor differences in the growth rates of fish at the five hard water sites, but these rates were higher than those for the same fish species in the softer Docken's Water. At all sites growth was most rapid in the spring and early summer and though growth continued throughout the year there was a considerable decrease in the rate during the winter months. Annual bullhead production ranged from 6.2 to 43.1 $g/m^2$ (fresh weight) in the hard-water streams and this represented from 43 to 83% of total fish production. Bullhead production was greatest during the first few months of life and was correlated directly with the density of the 0 group population. Trout production ranged from 2.6 to 12.9 $g/m^2$/annum (fresh weight) at the hard water sites and contributed from 7 to 37% to the total fish production at each site. There was a more even distribution of production among the age groups than in the bullhead, and trout production at each site was affected by the proportion of each age group present. In the soft water stream trout contributed 87% (12.1 $g/m^2$) of annual fish production, with most of the remainder coming from the minnow population. Bullheads did not occur in this stream. (Auth. summ.)

13790. Murphy, Philip G. (Hopkins Mar. Sta., Pacific Grove, California). 1971. THE EFFECT OF SIZE ON THE UPTAKE OF DDT FROM WATER BY FISH. Bull. Environmental Contamination and Toxicology, 6(1): 20-23.

Assuming that the difference in DDT uptake between trout and mosquitofish is related to their difference in size, one might expect an intraspecific relationship between size and DDT uptake. In regard to accumulation of DDT-$C^{14}$ from water by test mosquitofish of different sizes, the smallest fish were the most efficient at removing DDT from water with the efficiency diminishing rapidly as the fish increased in weight past 200 mg. The smallest fish tested acquired a mean DDT-$C^{14}$ concentration which was four times the mean concentration acquired by the

largest fish tested, but even these large mosquitofish were much more efficient at removing DDT from water than were approximately 100 gram trout. It has been reported that the food chain is the major source of DDT contamination in fish. Thus, if the relationship between size and DDT uptake reported here is of general application, direct DDT uptake from water may be of considerable importance to fish populations.

**13791.** Hiltibran, Robert C. (Ill. Natural History Survey, Urbana, Illinois). 1971. EFFECTS OF CADMIUM, ZINC, MANGANESE, AND CALCIUM ON OXYGEN AND PHOSPHATE METABOLISM OF BLUEGILL LIVER MITOCHONDRIA. J. Wat. Poll. Contr. Fed., 43(5): 818-823.

**13792.** Snyder, George R., and Theodore H. Blahm (Nat. Mar. Fish. Serv., U. S. Dept. of Commerce, Seattle, Washington). 1971. EFFECTS OF INCREASED TEMPERATURE ON COLD-WATER ORGANISMS. J. Wat. Poll. Contr. Fed., 43(5): 890-899.

Ejection of heat from large thermonuclear plants into the aquatic environment could result in declines of cold-water fish. It is apparent that some aquatic organisms indigenous to the Pacific Northwest have low tolerance to increases of temperature. Research is needed to define clearly the thermal tolerance and survival of these organisms over a wide range of environmental conditions. (From authors conclusions)

**13793.** Holmes, John C. (Dept. of Zool., Univ. of Alberta, Edmonton, Alberta, Canada). 1971. TWO NEW SANGUINICOLID BLOOD FLUKES (DIGENEA) FROM SCORPAENID ROCKFISHES (PERCIFORMES) OF THE PACIFIC COAST OF NORTH AMERICA. J. Parasit., 57(2): 209-216.

The sanguinicolid trematodes Aporocotyle macfarlani and Psettarium sebastodorum are named and described from scorpaenid rockfishes. Aporocotyle macfarlani was found in five species of Sebastodes from shallow coastal waters of the State of Washington and the Province of British Columbia. Psettarium sebastodorum is reported from eleven species of Sebastodes from the same waters or those of the adjacent continental shelf. The reproductive system of Psettarium tropicum Manter, 1940, is redescribed from the type and paratypes. The generic relationships of sanguinicolids with a reticulate testis are discussed. Cardicola davisi and C. klamathensis are returned to Sanguinicola and C. alseae is transferred to that genus. (Auth.)

**13794.** Johnson, Keith A. (Zool. and Entomol. Dept., Montana State Univ., Bozeman, Montana). 1971. THE MIGRATION OF Cotylurus erraticus CERCARIAE (TREMATODA: STRIGEIDAE) IN RAINBOW TROUT (Salmo gairdneri) AND THEIR EFFECTS ON THE HOST. J. Parasit., 57(2): 244-251.

The migration routes of C. erraticus cercariae were determined in laboratory-infected rainbow trout which were killed at twelve intervals from 0.5 to 48.5 hr after infection. Histological sections of these fish were stained and examined for cercarial bodies. The location and tissue were noted for each of 5,015 cercariae and migration routes were determined from the progressive movement of cercariae in the tissues and organs. The circulatory system and loose connective tissue served as migratory routes to the pericardium. The evidence suggests that the former was the more common route. Migration was nearly complete 8.0 hr after exposure. Some cercariae were found in the body cavity after 48.5 hr and suggested the body cavity as a second location for encysting cercariae. Hemorrhage was the primary effect of cercariae on fish but a small amount of tissue damage was also found. (Auth.)

**13795.** Joy, James E. (Dept. of Vet. Parasitol., Texas A & M Univ., College Station, Texas). 1971. Spirocamallanus pereirai (NEMATODA: CAMALLANIDAE) FROM THE CROAKER, Micropogon undulatus, IN TEXAS. J. Parasit., 57(2): p. 390.

**13796.** Gard, Richard (Bur. Commercial Fish. Biol. Lab., Auke Bay, Alaska). 1971. BROWN BEAR PREDATION ON SOCKEYE SALMON AT KARLUK LAKE, ALASKA. J. Wildlife Mgmt, 35(2): 193-204.

Effects of predation by brown bears (Ursus arctos) on sockeye salmon (Oncorhynchus nerka) were studied at Grassy Point Creek, a tributary of Karluk Lake on Kodiak Island, Alaska, during the summers of 1964 and 1965. In 1964 bears were allowed free access to the stream, but in 1965 an attempt was made to exclude them with an electric fence. Bears were efficient predators in the stream, killing up to 79 percent of the salmon in 1964; however, only 9.6 percent of the dead females sampled were unspawned bear-killed fish. The maximum estimate of eggs lost to bear predation in 1964 was about 1 million, compared with a total loss, from all causes, of 8 million potential eggs. As a result of certain behavioral patterns of sockeye salmon, bears usually take spawned-out rather than unspawned females. The ratio of males to females in each year's escapement approached 1:1; the ratio among bear kills was about 3:2. Males acted as a buffer against predation on females. The fence reduced bear predation by two-thirds. It is concluded that bear predation has little adverse effect on the production of sockeye salmon. (Auth.)

**13797.** McCombie, A. M., and Ivanka Wile. 1971. ECOLOGY OF AQUATIC VASCULAR PLANTS IN SOUTHERN ONTARIO IMPOUNDMENTS. Weed Science, 19(3): 225-228.

Aquatic plants and physical-chemical data were collected during 1969 from 19 ponds and lakes. The fertility of these waters, as indicated by specific conductance, appeared to be a function of watershed area over the range 0 to 100 hectares. For watersheds greater than 100 hectares, differences in soil type and farming intensity were major causes of variability. Chara (Chara spp.) was found at specific conductances from 96 to 445 micromhos/sq cm (at 18C) but was most abundant between 218 and 300. Chara also grew best in the upper half of the transparency range at Secchi disc readings varying from 2.4 to 5.8 m. Elodea (Elodea canadensis Michx.) flourished at specific conductances of 224 to 300 micromhos/sq cm and at transparencies from 2.7 to 5.8 m. Largeleaf pondweed (Potamogeton amplifolius Tuckerm.) was found only in the least fertile impoundment. Sago pondweed (P. pectinatus L.) occurred at specific conductances of 200 to 349 micromhos/sq cm but was most prolific from 229 upward. This species also favored extensive shallow areas subject to a continuous summer flow. (Authors)

**13798.** Hansen, D. J., P. R. Parrish, J. I. Lowe, A. J. Wilson, Jr., and P. D. Wilson (U. S. Environmental Protection Agency, Gulf Breeze Lab., Sabine Island, Gulf Breeze, Florida). 1971. CHRONIC TOXICITY, UPTAKE, AND RETENTION OF AROCLOR$^{R}$ 1254 IN TWO ESTUARINE FISHES. Bull. Environmental Contamination and Toxicology, 6(2): 113-119.

Study results suggest that chronic exposure to Aroclor 1254 increased susceptibility of test pinfish and spot to disease, and also appeared to be toxic to these fish. This PCB is rapidly stored by pinfish and spot, and persists in tissues for approximately three months. The findings emphasize the need for further study on the effect of chronic exposure of aquatic organisms to polychlorinated biphenyls. (Authors conclusions)

**13799.** Post, George, and Thomas R. Schroeder (Colo. State Univ., Fort Collins, Colorado). 1971. THE TOXICITY OF FOUR INSECTICIDES TO FOUR SALMONID SPECIES. Bull. Environmental Contamination and Toxicology, 6(2): 144-155.

DDT, endrin, carbaryl and malathion were bioassayed against brook trout, rainbow trout, cutthroat trout and coho salmon. TLm values and the confidence limits at 48, 72, and 96 hour intervals are given for each species of fish to each insecticide at two different body weights. The relationship between the mean 96 hr TLm values of the four insecticides to the four salmonid species are demonstrated.

**13800.** Plack, P. A., D. J. Pritchard, and N. W. Fraser (Nat. Environ. Res. Council Fish. Biochem. Res. Unit, Univ. of Aberdeen, St. Fittick's Road, Aberdeen, AB1 3 RA, U. K.). 1971. EGG PROTEINS IN COD SERUM. NATURAL OCCURRENCE AND INDUCTION BY INJECTIONS OF OESTRADIOL 3-BENZOATE. Biochem. J., 121(5): 847-856.

1. Before the uptake of water that precedes spawning, eggs of cod (Gadus morhua L.) contained 30% dry matter, of which 80% was protein. Some 75% of this protein was soluble in 0.5 m-sodium chloride. The major components in the extract were two similar lipoproteins, of molecular weight about 400,000, containing 21% lipid, some two-thirds of which was phospholipid, and about 0.5% protein phosphorus. 2. These lipoproteins were identified by immunochemical methods in the serum of female cod with developing ovaries, but not in the serum of male or of immature female fish. 3. The concentrations of egg proteins in the serum of female cod were determined by a serial-dilution double-diffusion immunological method, and were shown to increase with development of the ovaries, reaching a value of about 32 mg/ml when the weight of the ovaries was 10% of the weight of the fish. 4. Immature male and female cod were injected intramuscularly with a solution of oestradiol-17$\beta$ 3-benzoate in oil and the concentration of egg proteins in their serum was measured by the immunodiffusion method. The serum contained no detectable egg proteins before injection of the fish, but 30 μg of oestradiol benzoate/kg gave rise to detectable amounts of egg proteins in 10 days, and with 300 μg or 1 mg of oestradiol benzoate/kg the concentration of egg proteins rose to 32 mg/ml. The values for male and female cod were similar and represented about one-half of the total serum protein. 5. With a dose of 1 mg of oestradiol benzoate/kg, egg proteins were first detected in the serum 2 days after injection and the concentration increased up to 10 days. 6. Serum samples taken before and 10 days after an injection of 1 mg of oestradiol benzoate/kg were fractionated by gel-filtration on Sephadex G-200. The difference curves obtained from fractionation curves after and before injection confirmed the values of the concentrations of egg proteins obtained from the immunodiffusion test and showed that the concentrations of the normal serum components fell by 20-50% of the initial value, the high-molecular-weight globulins showing the most marked fall. 7. Egg proteins were detected in the liver and testes of the injected fish, but not in the ovaries. (Authors)

**13801.** Liu, O. C., D. A. Brashear, H. R. Seraichekas, J. A. Barnick, and T. G. Metcalf (Northeastern Water Hygiene Lab., Div. of Water Hygiene, EPA, Narragansett, Rhode Island). 1971. VIRUS IN WATER. I. A PRELIMINARY STUDY ON A FLOW-THROUGH GAUZE SAMPLER FOR RECOVERING VIRUS FROM WATERS. Applied Microbiology, 21(3): 405-410.

A preliminary study was carried out on evaluating a flow-through gauze sampler for its efficiency in recovering virus from both fresh and seawater. An attenuated type 1 poliovirus was used as the working model. When tap water was sampled, the amounts of virus adsorbed by the gauze pads were very small, about 2% of the total number of virus particles flowing through the device. The virus adsorption and recovery increased to 15 to 19% when seawater was sampled. Addition of NaCl to tap water produced a much better effect on virus adsorption and recovery by this device, i.e., 47% of the total virus particles in each sample. The best viral elution from the pads was obtained by using buffer solution of pH 8.0 to 9.0 containing a small amount of animal serum. Repeated elutions from the pads were necessary to recover the most virus although the first eluate contained approximately 50% of the adsorbed virus. Further development of this device appears warranted, because of (i) the simplicity of the procedure, (ii) its capability of sampling large volume of water, (iii) the low cost of collecting samples, and (iv) the feasibility of obtaining a rough quantitative assessment of viral pollutants in water examined. (Authors)

**13802.** Zitko, V., and S. N. Tibbo (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, New Brunswick, Canada). 1971. FISH KILL CAUSED BY AN INTERMEDIATE OIL FROM COKE OVENS. Bull. Environmental Contamination and Toxicology, 6(1): 24-25.

13803. Yarbrough, James D., and Marion R. Wells (Dept. of Zool., Miss. State Univ., State College, Mississippi). 1971. VERTEBRATE INSECTICIDE RESISTANCE: THE IN VITRO ENDRIN EFFECT ON SUCCINIC DEHYDROGENASE ACTIVITY ON ENDRIN-RESISTANT AND SUSCEPTIBLE MOSQUITOFISH. Bull. Environmental Contamination and Toxicology, 6(2): 171-176.

From this study, there is evidence that vertebrate resistance involves a cellular membrane barrier. Endrin inhibition of succinic dehydrogenase activity in resistant tissue only after the mitochondrial membrane is disrupted clearly demonstrates a membrane barrier that is effective in the resistance mechanism. (From auth.)

13804. Hunter, John R., and James R. Zweifel (NMFS, Fish.-Oceanog. Center, LaJolla, California). 1971. SWIMMING SPEED, TAIL BEAT FREQUENCY, TAIL BEAT AMPLITUDE, AND SIZE IN JACK MACKEREL, Trachurus symmetricus, AND OTHER FISHES. U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 253-266.

The tail beat frequency and tail beat amplitude of jack mackerel, Trachurus symmetricus, 4.5 to 27.7 cm were measured at speeds of 15 to 212 cm/sec. Tail beat amplitude was a constant proportion of length at all speeds but tail beat frequency changed with speed; thus speed depended only on frequency of the tail beat and length. A simple mathematical model for estimating swimming speed from tail beat frequency and fish length was derived from the Trachurus data and applied to data for three marine fish — Scomber japonicus, Triakis henlei, and Sardinops sagax — and to data for freshwater fish from the literature. The general form of the model was $V - V_o = L(KF - F_o)$ where V is fish speed, $V_o$ is length-dependent minimum swimming speed at minimum tail beat frequency $F_o$, and L is fish total length. The model represented a major improvement over previous equations because it provided an unbiased correction for length, was sensitive to specific differences, and provided a more accurate estimation of speed. (Authors)

13805. Hunter, John R. (NMFS, Fish.-Oceanog. Center, LaJolla, California). 1971. SUSTAINED SPEED OF JACK MACKEREL, Trachurus symmetricus. U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 267-271.

Jack mackerel, Trachurus symmetricus, were forced to swim for up to 6 hr at various speeds in an activity chamber. The probit estimate for the swimming speed at which 50% of Trachurus would fatigue during 6 hr was 93.4 cm/sec (8.4 L/sec) for fish 10.0 to 11.9 cm and was $22.4\ L^{0.6}$/sec for fish 9.0 to 17.6 cm where L is the total length of the fish in centimeters. At higher speeds, Trachurus, 15 cm, swam for 3 min at 160 cm/sec or 10 L/sec. The swimming speed at which 50% fatigued declined exponentially with time for about the first 22 min of swimming and thereafter declined linearly with time. The possible significance of the time-speed relationship for Trachurus is discussed. (Auth.)

13806. Leong, Roderick (NMFS, Fish.-Oceanog. Center, LaJolla, California). 1971. INDUCED SPAWNING OF THE NORTHERN ANCHOVY, Engraulis mordax Girard. U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 357-360.

Anchovies were induced to mature their gonads by an artificial photoperiod of 4 hr light and 20 hr darkness at 15°C. Single injections of suspensions of salmon pituitary, carp pituitary, or a solution of human chorionic gonadotropin (HCG) promoted increase in egg diameters but did not induce spawning. Two injections, a first of HCG and the second 2 days later of either salmon pituitary or carp pituitary, induced spawning. At each spawning 6,000 to 16,000 eggs were collected, and 25% to 80% of the eggs hatched. Larvae grown from these eggs were morphologically similar to those caught in the sea. (Auth.)

13807. Shaw, T. L., and V. M. Brown (Water Poll. Res. Lab., Elder Way, Stevenage, Hertfordshire, England). 1971. HEAVY METALS AND THE FERTILIZATION OF RAINBOW TROUT EGGS. Nature, 230(5291): p. 251.

Copper at a concentration of 1.0 mg $Cu^{++}l.^{-1}$ and nickel at a concentration of 1.0 mg $Ni^{++}l.^{-1}$ did not impair fertilization of rainbow trout eggs.

**13808.** Magnuson, John J., and Jean G. Heitz (Lab. of Limnology, Dept. of Zool., Univ. of Wisconsin, Madison, Wisconsin). 1971. GILL RAKER APPARATUS AND FOOD SELECTIVITY AMONG MACKERELS, TUNAS, AND DOLPHINS. U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 361-370.

Gill raker morphology and fork length were measured from 411 fish, representing eight species of scombrids and two species of coryphaenids (dolphin). For each species linear regressions passing through the origin were determined relating mean gill raker gap in millimeters (first gill arch) with fork length in centimeters (l), and log filtering area (first gill arch) with log fork length. Mean gill raker gaps equaled: Auxis rochei - 0.0144 l, Katsuwonus pelamis - 0.0211 l, Auxis thazard - 0.0213 l, Thunnus albacares - 0.0344 l, Thunnus alalunga - 0.0365 l, Euthynnus affinis - 0.0386 l, Thunnus obesus - 0.0391 l, Sarda chiliensis 0.0509 l, Coryphaena hippurus - 0.0650 l, Coryphaena equisetis - 0.0655 l, and Acanthocybium solanderi - no gill rakers. Among the species gill raker gap was directly proportional to the number of gill rakers, but no relation occurred between mean gap and filtering areas. Gill raker gap differed markedly among species and lengths of fish. A 50-cm K. pelamis, a 30-cm T. albacares, and a 10-cm Sarda orientalis all had an estimated mean gap of 1 mm. Conversely the gaps of a 50-cm fish of each species were estimated to be ca. 1.0, 1.7, and 4.5 mm respectively. Mean gill raker gaps from this study were compared with the percentage of crustaceans in stomachs of Central Pacific fishes based on literature records. Body sizes of fishes and squids in the stomachs were larger than crustaceans. Percent volumes that crustaceans contributed to the stomach content were inversely related to mean gaps (Kendall rank correlation coefficient, = -0.59, n = 16, P 0.01). Partial correlation indicated that gap was more important than fork length in predicting the quantity of crustaceans. Thus, the gill raker gap was related functionally with the quantity of smaller organisms in the stomachs. Presence of euphausids in stomachs of K. pelamis and their absence in T. albacares from the eastern tropical Pacific may result from the small size of euphausids and the smaller gill raker gaps of K. pelamis relative to T. albacares. Gill raker gap and the maximum distensibility of the esophagus would set physical limits on the size of food eaten. The diverse fauna assemblage of crustaceans, fishes, and squids within this size range has masked to a great extent the selective feeding that does occur among scombrids and coryphaenids on the basis of food size. (Authors)

**13809.** Pritchard, Austin W., John R. Hunter, and Reuben Lasker (Zool. Dept., Oregon State Univ., Corvallis, Oregon). 1971. THE RELATION BETWEEN EXERCISE AND BIOCHEMICAL CHANGES IN RED AND WHITE MUSCLE AND LIVER IN THE JACK MACKEREL, Trachurus symmetricus. U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 379-386.

Glycogen, lactic acid, and fat concentration in red and white muscle and glycogen in the liver of jack mackerel, Trachurus symmetricus, were measured after periods of forced swimming by Trachurus at speeds above, below, and at the sustained speed threshold. Failure to swim at any speed was associated with an almost complete depletion of glycogen in the white muscle only. The trend of glycogen use in the red muscle closely followed that of the liver and was not correlated with failure to swim. Reduction of glycogen levels in red muscle and liver were associated with extended periods of swimming. High lipid content was characteristic of e. A decline in lipid concentration after exercise occurred only in the red muscle and only after a swimming period of 6 hr at a subthreshold speed. High lactate levels were characteristic of both muscle types and did not appear to be related to fatigue at any swimming speed. The high lactate levels in white muscle, the almost complete depletion of glycogen in the white muscle of exhausted fish, and the parallel pattern of glycogen depletion in red muscle and liver suggested that white muscle was the primary locomotor organ near and above the threshold for sustained speed. At these speeds red muscle like the liver may provide nutrients to the white muscle, provided time for mobilization is sufficient. At speeds below the sustained speed threshold our analysis indicated that both the red and white muscle systems were used but the relative significance of the locomotory role played by each system could not be evaluated. (Authors)

**13810.** Quast, Jay C. (NMFS Biol. Lab., Auke Bay, Alaska). 1971. Sebastes variegatus, SP. N. FROM THE NORTHEASTERN PACIFIC OCEAN (PISCES, SCORPAENIDAE). U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 387-398.

A new scorpaenid fish, Sebastes variegatus, from the Gulf of Alaska is characterized by an elongate body that tapers symmetrically anteriorly and posteriorly; presence of preocular, postocular, tympannic, and parietal spines and lack of supraocular, coronal, and (usually) nuchal spines; 18 (rarely 17 or 19) rays in the pectoral fin; a second anal fin spine that is longer than the third; black membranes in the spinous dorsal and caudal fins; a dark brown to jet black peritoneum; and a darl blotched pattern on the sides that is interrupted over the posterior 2/3 of the body by an unpigmented band along the lateral line. The known geographic range is from Unimak Pass (Aleutian Islands) to Queen Charlotte Sound (British Columbia). (Auth.)

**13811.** May, Robert C. (Scripps Inst. of Oceanog., Univ. of Calif., San Diego, LaJolla, California). 1971. EFFECTS OF DELAYED INITIAL FEEDING ON LARVAE OF THE GRUNION, Leuresthes tenuis (Ayres). U. S. Dept. Commerce, NOAA, NMFS, Fish. Bull., 69(2): 411-425.

The initial feeding of newly hatched larvae of the grunion, Leuresthes tenuis (Ayres), was delayed for various periods of time under laboratory conditions at 18°C. Unfed larvae did not develop morphologically beyond the stage reached at the time of yolk absorption, about 4 days after hatching, although some survived as long as 3 weeks. Regardless of how long initial feeding was delayed, 80% or more of previously unfed larvae began feeding when food was made available to them, and at least 40% of the larvae alive when food was offered were able to survive to the end of a 20-day experiment. Some larvae feeding for the first time after 1 to 2 weeks without food, died after gorging themselves with Artemia nauplii. When food was offered to starved larvae, growth began and generally proceeded at about the same rate as in larvae fed from day 1, although there was some indication that a few days' delay in initial feeding increased the conversion efficiency of grunion larvae feeding on Artemia nauplii. Catabolism of fat provided most of the energy for metabolic processes during starvation. The condition factors and carbon/nitrogen ratios of unfed larvae were below those of fed larvae; condition factor seemed to be the better index of nutritional state. Grunion larvae probably do not experience high mortality at sea due to starvation, nor do they exhibit a classical "critical period" at the time of yolk absorption. (Auth.)

**13812.** Whitt, Gregory S. (Dept. of Zool., Univ. of Ill., Urbana, Illinois). 1971. EVOLUTION OF LACTATE DEHYDROGENASE GENES IN FISH. Reprint from The Isozyme Bulletin, Vol. 4:30.

In some species of fish there is a retinal specific lactate dehydrogenase isozyme, $E_4$ isozyme. This isozyme has recently been shown to be closely related to the $B_4$ isozyme (found predominantly in aerobic tissues such as heart) on the basis of kinetic, physical, and immunochemical studies. The electrophoretic mobility of the $E_4$ isozyme is different for smallmouth and largemouth bass. The $F_1$ interspecific hybrid formed from these two species has the expected hybrid isozyme pattern. The $F_2$ and $F_3$ hybrid generations were formed and the three phenotypes, LMB, Hybrid, and SMB are present in a 1:2:1 ratio and are equally distributed among males and females. This data indicates the Mendelian inheritance of the locus (E gene) encoding the $E_4$ isozyme as well as the autosomal location of the gene. In addition, in the bass the LDH E gene does not appear to be linked to the supernatant MDH-B locus. In these species of bass the LDH E gene also functions in such non-neural tissues as heart and kidney. Examination of the blind cave fish and closely related sighted species of characins reveals that they do not possess an $E_4$ isozyme. An extensive survey of teleostean and non-teleostean fish was undertaken to determine where the $E_4$ isozyme (and the E gene) first appeared during the course of evolution. The retinal specific $E_4$ isozyme was not detected in any species examined from the following groups of fish: agnathans, chondrichthyes, dipnoans, chondrosteans, and holosteans. The function of the LDH E gene appears to be restricted to the teleosts. However, some orders of teleosts

(primitive teleosts), e.g., Cypriniformes, contain many families which lack the $E_4$ isozyme. This data has been interpreted as suggesting that the B gene duplication giving rise to the E gene occurred sometime prior to the adaptive radiation of the teleosts. The A and B loci of primitive fish do not appear to have diverged to the same extent as these loci in teleosts as shown by the fact that antiserum against the $B_4$ (or $A_4$) homopolymer of an advanced teleost does not usually cross-react with the heterologous homopolymer. However, the same antiserum will cross-react with both homopolymers from more primitive fish. (Auth.)

**13813.** Gilpin, B. R., and M. A. Brusven (Biol. Dept., Valley Center High School, Valley Center, Kansas). 1970. FOOD HABITS AND ECOLOGY OF MAYFLIES OF THE ST. MARIES RIVER IN IDAHO. Melanderia, Vol. 4, pp. 19-40, published by Washington State Entomological Society.

The food habits and ecology of 12 genera and 31 species of mayflies from the St. Maries River were studied. Nymphs of the St. Maries River were basically herbivorous, feeding largely on detritus, diatoms, and filamentous algae. Food habits for most species varied little from habitat to habitat. Intermediate stage and older age-class nymphs usually had similar feeding habits. The distribution of mayfly nymphs of the St. Maries River was variable. Species such as Cinygmula sp. and Ephemerella tibialis had a wide distribution adapting to a variety of habitats while Epeorus grandis, Centroptilum sp., and Heptagenia solitaria had limited distributions. We believe conditions of the micro-habitats greatly influence mayfly distribution. Different mayflies generally had different environmental requirements. Nymphs such as Paraleptophlebia bicornuta, P. heteronea, and P. memorialis had strong affinities to habitats having considerable detritus, while nymphs of Epeorus grandis and Ephemerella edmundsi frequented more silt and detrital-free habitats. The principal physical factors influencing the distribution of mayflies on the St. Maries River are believed to be bottom type and current speed. Moderately-flowing, lightly-silted cobble riffles supported the largest populations of mayfly nymphs. (Authors summ.)

**13814.** Jefferies, D. F., and C. J. Hewett (Ministry of Agric., Fish., and Food, Fisheries Radiobiological Lab., Lowestoft, Suffolk, United Kingdom). 1971. THE ACCUMULATION AND EXCRETION OF RADIOACTIVE CAESIUM BY THE PLAICE (Pleuronectes platessa) AND THE THORNBACK RAY (Raia clavata). J. mar. biol. Assoc. U.K., 51(2): 411-422.

The patterns of accumulation of caesium-134 by the organs and tissues of the plaice Pleuronectes platessa L., a marine teleost, and the thornback ray Raia clavata L., a marine elasmobranch, are described. Estimates of the biological half-time and steady-state concentrations in relation to sea water are derived, using a simple exponential model. The rate processes are examined again in an experiment to measure the rate of loss of caesium-134 from fish after a period of accumulation. The biological half-time, at 10°C, for caesium-134 in the muscle of plaice of 30 g weight is estimated to be 120-140 days, and in rays of 80 g weight 180-190 days. In all other tissues and organs examined the rate processes in the plaice are faster than in the ray. Estimates are made of the amount of caesium obtained from water and from food. It is concluded that the plaice obtains at least 50% of its caesium body burden from food and the ray probably more than 80%. Caesium is absorbed from water via the gut in both species, but whereas in the plaice this accounts for up to 50% of the intake from water, in the ray this is probably a much smaller pathway. Excretion in both species appears to be 90% extrarenal. (Authors)

**13815.** Matsumura, F., K. C. Patil, and G. M. Boush (Dept. of Entomology, Univ. of Wis., Madison, Wisconsin). 1971. DDT METABOLIZED BY MICROORGANISMS FROM LAKE MICHIGAN. Nature, 230(5292): 325-326.

A study of the metabolism of DDT by microorganisms isolated from water and bottom silt of Lake Michigan and related water systems is described.

**13816.** Hartman, Wilbur L. (NMFS Biol. Lab., Auke Bay, Alaska). 1971. ALASKA'S FISHERY RESOURCES - THE SOCKEYE SALMON. U. S. Dept. Commerce, NOAA, NMFS, Fishery Leaflet 636, 8 p., illus.

Sockeye salmon, Oncorhynchus nerka, are produced in river-lake systems in Canada, Alaska, and the Soviet Union. Alaska production has averaged $32 million to the wholesaler annually since 1945; the value was $72 million in 1965. Female sockeye salmon carry about 3,500 eggs and spawn in late fall in lake inlets and outlets and even the lakes themselves. The following spring, inch-long fry emerge and migrate at night to the lakes. After spending 1 to 4 years growing in the nursery lakes, the fish migrate in schools to the feeding grounds far out in the Pacific Ocean. After 1, 2, or 3 years at sea, the maturing sockeye salmon return through the coastal waters to the freshwater spawning grounds. Sockeye salmon when grown weigh 6 to 9 lb and average 24 inches long. They are captured by a Japanese high seas gill net fishery, an American inshore gill net fishery, and the Alaska native subsistence fishery in the rivers and lakes. The State of Alaska manages the inshore fishery. The National Marine Fisheries Service provides the basis for research needed for rational management and international protection of this valuable natural resource. (Auth.)

**13817.** MacDonald, J. Rod (Fish. Serv., Dept. of Fish. and Forestry of Canada, Halifax, Nova Scotia, Canada). 1971. DELAYED MORTALITY OF ATLANTIC SALMON (Salmo salar) PARR AFTER FOREST SPRAYING WITH DDT INSECTICIDE IN NEW BRUNSWICK. Dept. of Fisheries of Canada, Halifax, N. S., Resource Development Branch Progress Report No. 2.

Delayed mortality of juvenile Atlantic salmon (Salmo salar) in the Miramichi River system was studied in the fall months of 1964, 1965 and 1966 as part of a continuing program to assess the effects of forest insecticide spraying practices on salmon. Dead salmon parr were observed in some spray-area streams approximately four months after the spraying of DDT for forest insect control. These delayed mortalities occurred despite the fact that phosphamidon "safety zones" were maintained along major streams. The mortalities occurred when water temperatures declined to 5°C. Parr mortality was most extensive when body condition of the fish was poor. Most of the dead parr were precocious males. Underyearling salmon apparently were not affected during the fall mortality period. The observations suggest that several related factors, specifically, body condition, population density and sexual maturation influence the susceptibility of salmon parr to DDT poisoning. (Auth.)

**13818.** Ozaki, Hisao, Kazuo Uematsu, and Koji Tanaka (Tokyo Univ. of Fish., Tokyo, Japan). 1970. SURVIVAL AND GROWTH OF GOLDFISH AND CARP IN DILUTE SOLUTIONS OF COPPER SULPHATE. Jap. J. Ichthyol., 17(4): 166-172. In Japanese with English abstract).

Subacute and chronic intoxication of copper sulphate on goldfish and carp were tested under lower concentrations than those in usual cases of TLm test in 24 or 48 hours. The effects were measured, in tanks containing 48 or 50 l of water, with 5 fish of similar size as one experimental lot, with regard to maximum and minimum periods of survival (days), the growth in length and weight of body, the condition factor and amount of food consumed. The temperature of the water was kept at 23 ± 1°C, and pH value at 5.7 ± 0.1 during the test extending the maximum of 30 days. Also, seven kinds of copper compounds were examined on the survival (in hours) of carp. The concentrations which permitted survival for more than 30 days were 0.17 ppm for goldfish, and 0.08 for carp in the maximum, and growth decreased at 0.08 ppm for goldfish and 0.024 for carp in the minimum. The amount of food consumed decreased to 70% at the concentration of 0.008 ppm in carp against 100% at 0 ppm, though the fish survived more than 30 days in apparent healthy condition at this low concentration. The decrease of food intake by carp was believed to have resulted from the toxic effects of copper sulphate on the mucous epithelia and on the enzymes in the digestive tract as usually observed in mammals. The results indicate that safe concentrations of copper sulphate for fish should be determined on the basis of subacute or chronic bioassays rather than on the usual short-term TLm test.

**13819.** Lehmann, Johannes (Zoologisches Inst. der Universität Kiel, West Germany). 1970. CHANGES OF ENZYMES ACTIVITIES AFTER ALTERING THE TEMPERATURES OF ADAPTATION EXAMINED ON THE SIDETRUNK MUSCLE OF GOLDFISH (Carassius auratus L.). [Veränderungen der Enzymaktivitäten nach einem Wechsel der Adaptationstemperatur, untersucht am Seitenrumpfmuskel des Goldfisches (Carassius auratus L.).] Int. Revue ges. Hydrobiol., 55(5): 763-781. (In German with English summary).

After an abrupt change in the adaptation temperature (AT) from 15° to 5°C, the activities of several enzymes in the sidetrunk muscle of goldfishes (Carassius auratus L.) were observed for 168 hours. At the beginning, enzyme-specific fluctuations were apparent. After 48-72 hours the values became relatively constant. These, however, did not attain the level of activity of the fishes, which have been adapted for a long period at 5°C. Besides these enzymes the nucleic acids of the muscle have been quantitatively ascertained. The alterations in the DNA content are small. On the contrary, the RNA values show a short lasting initial increase. It is assumed that this increase and the alterations in the enzyme-activity were merely because of the abrupt change in temperature, and thus have no great significance for the capacity adaptation. The goldfishes were cooled down from 15° to 5°C (about 1°/3 min) and then finally placed back into the initial temperature. To some extent alterations were apparent similar to those occuring after the AT change (15° to 5°C). Differences could be established especially in the dehydrogenases which are dependent on NADH. In these experiments the RNA content has also been measured. It shows a similar increase as above, which, however, begins earlier. (Auth. summ.)

**13820.** Gutz, Manfred (Zoologisches Inst. der Universität Saarbrücken, West Germany). 1970. EXPERIMENTAL STUDIES ON ADAPTATION TO SALINITY SHOWN BY THE DIFFERENT RACES OF THE THREE-SPINED STICKLEBACK (Gasterosteus aculeatus L.). [Experimentelle Untersuchungen zur Salzadaptation verschiedener Rassen des Dreistachligen Stichlings (Gasterosteus aculeatus L.)]. Int. Revue ges. Hydrobiol., 55(6): 845-894. (In German with English summary).

The adaptation to salinity shown by the different races of the three-spined stickleback Gasterosteus aculeatus has been studied by measuring the height of the pool of free amino acids and the consumption of oxygen. The values for the pool of free amino acids and for the consumption of oxygen indicate no fundamental differences between the trachurus- and the semiarmatus-sticklebacks. If there are any differences, they can be attributed to the occurrence of heterosis. Concerning their modes in adaptation to salinity the trachurus- and semiarmatus-sticklebacks on the one hand show opposite reactions with the leiurus-sticklebacks on the other hand. The osmoregulation of the leiurus-sticklebacks in sea-water functions without any energy consumption but by using the pool of free amino acids. This mechanism of osmoregulation turns out to be not effective enough in cold sea-water. Thyroxine is able to compensate this deficiency. The osmoregulation of the trachurus- and semiarmatus-sticklebacks in sea-water takes place, as the increased oxygen consumption shows, by using the mechanism of active transport and not passively via the pool of free amino acids. During the time of gonadal development, however, the mechanism of active transport loses its effectiveness. As can be derived from the ascent of the pool of free amino acids during this time, the trachurus- and semiarmatus-sticklebacks are using the method of osmoregulation in addition which, actually, is typical of the leiurus-sticklebacks. Thyroxine lowers the pool of free amino acids and the water-contents of the muscle-tissues and increases the oxygen consumption of the sticklebacks. Thyroxine accelerates gonadal development, thiourea delays or prevents it. The trachurus- and semiarmatus-sticklebacks attain maturity about four weeks earlier than the leiurus-sticklebacks. The sensitivity of the tissues towards thyroxine is higher with the trachurus- and semiarmatus-sticklebacks than with the leiurus-sticklebacks. The results of these inquiries lead to the assumption that the trachurus- and semiarmatus-sticklebacks possess a higher activity of the thyroid gland subsequently followed by a higher pool of thyroxine than the leiurus-sticklebacks. In respect to their osmoregulatory properties the trachurus- and semiarmatus-sticklebacks

can be affiliated to the marine fishes and the leisurus-sticklebacks to the freshwater fishes. The results obtained from this research are discussed with regard to the differences in distribution and migratory habits shown by the three races of the three-spined stickleback and in connection with the problem of osmoregulation in general. (Auth. summ.)

13821. Hines, R., and A. Yashouv (Fish Culture Res. Sta., Dor, Israel). 1970. PRELIMINARY STUDIES ON MUSCLE PROTEIN POLYMORPHISM OCCURRING WITHIN THE GENUS Tilapia. Bamidgeh, 22(3): 69-71.

Five species of Tilapia were examined by electrophoresis. The variation between Tilapia aurea and T. volcani is very slight and further studies will be required to determine if significant differences occur within the muscle myogens of these fish to allow species differentiation. Although morphological variation was found to exist between T. aurea from Kibbutz Ginossar, T. aurea from Dor, and T. aurea from the springs of Ein Feshka, no significant variation was detected between the muscle protein patterns of these three fish. The electrophoregrams of T. zilli, T. mossambica, and T. galilaea are quite distinct and it was found that these three species can be readily identified by their muscle myogen patterns.

13822. MacDonald, J. Rod. 1968. SOME EFFECTS OF FOREST SPRAYING ON ATLANTIC SALMON (Salmo salar) IN NEW BRUNSWICK. Dept. of Fisheries of Canada, Halifax, N. S., Resource Development Branch Progress Report No. 1.

Studies were conducted to determine the effects of aerial spraying of insecticides on Atlantic salmon (Salmo salar) during the period 1960 to 1966. Short term mortality of caged juvenile salmon was about 90 percent when one-half pound DDT (or two quarter-pound applications) per acre was sprayed, and was about 50 percent when a single quarter-pound of DDT per acre was sprayed. Most of the short term mortality occurred within one week of spray application. Phosphamidon and Sumithion were not toxic to young salmon at these concentrations. The short term mortality (over a period of 10 days) of young salmon was greatly reduced when phosphamidon spray was applied over the stream-side forests and DDT sprayed over the rest of the forest area. Native stream populations of one and two year old parr were unaffected where this phosphamidon safety zone spraying was done and native underyearling stocks were not seriously depleted. Sumithion spraying caused significant reductions in stream bottom organisms. An exposure of caddis fly larvae to phosphamidon spraying caused no significant mortality. (Auth.)

13823. Avtalion, R. R., Z. Malik, E. Lefler, and E. Katz (Rapaport Labs. for Microbiol., Bar-Ilau Univ., Ramat Gan, Israel). 1970. TEMPERATURE EFFECT ON IMMUNE RESISTANCE OF FISH TO PATHOGENS. Bamidgeh, 22(2): 33-38.

Carp immunized with soluble antigen (BSA), and kept at 25°C responded immunologically by relatively high titers of antibodies. Antibody production is completely inhibited at 12°C and 14°C. Under certain conditions, fish are able to produce antibodies even at these low temperatures. Carp are shown to possess immunological memory which is conserved for long periods of time at both low and high temperature. It is suggested that when microbial antigens are injected they will, in most cases, directly induce a secondary response which will be expressed by the ability of the fish to react at low temperature against them. Finally, it is suggested that keeping of the young fish at optimal temperature, in contact with selected fish pathogenic microorganisms, before their transfer to the rearing ponds in the cold season of the year, could lead to acquisition of immunity to these pathogens. (Authors summ.)

13824. Yashouv, A., and E. Berner-Samsonov (Fish Culture Res. Sta., Dor, Israel). 1970. CONTRIBUTION TO THE KNOWLEDGE OF EGGS AND EARLY LARVAL STAGES OF MULLETS (MUGILIDAE) ALONG THE ISRAELI COAST. Bamidgeh, 22(3): 72-89, illustrations and tables.

Spawning seasons, eggs, pigmentation, and development are described for Mugil chelo, M. capito, M. auratus, M. cephalus and M. saliens. A key to the eggs and early larval stages of the mullets along the Israeli coast is given.

**13825.** Wohlfarth, G., and Rom Moav (Fish Culture Res. Sta., Dor, Israel). 1970. THE EFFECTS OF VARIATION IN SPAWNING TIME ON SUBSEQUENT RELATIVE GROWTH RATE AND VIABILITY IN CARP. Bamidgeh, 22(2): 42-47.

The effects of a one day difference in spawning on relative growth and viability in carp was investigated by consecutive spawning and the use of recessive genetic markers affecting body coloration. The results show the adverse effect on growth and viability when the later-spawned group competes with the earlier spawned group in the same pond. It was demonstrated that bearers of genotypes for faster growth rate are capable of overcoming the initial disadvantage of being the later spawned and hatched. It was also found that mortality of the later-spawned was several times higher than that of the earlier spawned, regardless of their genotypes. (Authors)

**13826.** Taylor, Angela E. R., and R. Muller (editors). 1970. FISH PARASITOLOGY. Aspects of Fish Parasitology (Symposia of the British Soc. for Parasitology, Vol. 8, 167 pp. Published by Blackwell (Scientific), Oxford and Edinburgh, England) Price 60s; Nature 227(5263) : 1169-1170; Commercial Fisheries Abstracts, 24(1): p. 32. Carl J. Sindermann, reviewer.

This book contains a collection of six papers -- helminthological in emphasis -- on parasites of certain fresh-water and marine fishes. It is primarily of interest to parasitologists and fishery biologists but should also benefit specialists in other disciplines.

**13827.** Nyman, O. L. (Fish. Res. Bd. Canada, Biol. Sta., St. John's, Newfoundland, Canada). 1970. ECOLOGICAL INTERACTION OF BROWN TROUT, Salmo trutta L., AND BROOK TROUT, Salvelinus fontinalis (Mitchill), IN A STREAM. Canad. Fld Nat., 84(4): 343-350.

The present paper is meant to analyse some of the ecological factors involved in the sympatric occurrence of brown trout and brook trout in a stream in southeastern Newfoundland. Brook trout were found in the least favourable niches in the pools or in areas of shallow rapids. No sea-run brook trout were encountered, possibly as a result of selection against alleles determining downstream migration. The brook trout population, which was only found in part of the river is probably maintained by involuntary stocking from small tributaries, which are inaccessible to ascending fish. Downstream from the area of sympatry, brook trout are absent possibly because of heavy pollution and upstream (in the absence of restocking from brooks) because of domination and predation by brown trout and differential catchability by anglers. No food segregation between the two species was apparent in the area of sympatric occurrence, which should favour the larger and sometimes piscivorous brown trout. Food selectivity was low for both species and no species specific trends could be detected. Samples of stomach contents from areas where the species were allopatric displayed that food composition varies obviously with the relative abundance of the food objects. (Auth.)

**13828.** Jessop, B. M., R. L. G. Lee, and G. Power (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1970. OBSERVATIONS ON THE FISH FAUNA OF THE LEAF RIVER, UNGAVA. Canad. Fld Nat., 84(4): 365-367.

Species of fish in decreasing order of abundance were: Salvelinus fontinalis, Prosopium cylindraceum, Salvelinus alpinus, Salmo salar, Catostomus catostomus, Cottus cognatus, Salvelinus namaycush, Coregonus clupeaformis, Lota lota, Gasterosteus aculeatus, Pungitius pungitius. Brief notes are provided on each species. (Authors)

**13829.** Fedoruk, Alex N., J. J. Keleher, and D. C. Windsor (Manitoba Dept. of Mines and Nat. Resources, Winnipeg, Manitoba, Canada). 1970. FIRST CANADIAN RECORD OF THE BIGMOUTH SHINER, Notropis dorsalis (Agassiz). Canad. Fld Nat., 84(4): 391-394.

Bigmouth shiners, Notropis dorsalis (Agassiz), were collected in fish samples taken from the Pembina River and two of its tributaries in Manitoba. This record establishes the first occurrence of this species in Canada. Some characteristics of the species and observations on distribution in Manitoba are provided. (Authors)

13830. Tanaka, Tetsuhiko, Teruo Ishida, Hiroshi Matsukawa, Yoshiro Ishikawa, and Michio Kunda. 1971. STUDIES ON THE PLANTING OF HATCHERY-CULTURED MASU SALMON FRY INTO STREAMS. I. OBSERVATIONS ON DISPERSAL AND RESIDUARY OF JUVENILES IN THE MENA RIVER AND ITS TRIBUTARIES. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 1-17. In Japanese with English summary.

Observations were carried out on the dispersal and residuary of 2, 320 thousand hatchery-cultured Masu salmon (Oncorhynchus masou) fry released into the Mena River, a branch of the Shiribetsu River in 1970. The fry were released in the upper part of the tributaries, except 500 thousand fry liberated from the hatchery outlet and 300 thousand adipose-fin-clipped fry released at the uppermost part of the main stream. One preliminary and five tracing surveys were made in May through September at nine stations in the main stream and some stations in the tributaries. In every survey, distribution of marked and unmarked fish, and size of fish were observed. In late July and late September, abundance of fish at some stations was estimated by marking and repeated sampling method. The fry released in the main stream dispersed widely from point of release to downstream at least 10 km below, within 24 hours after planting. Tributary-released fry, except those planted in dammed standing waters, dispersed to the mouth of brook within 1 or 2 days. A tendency to move upstream was seen soon after planting the fish in the main stream. The tendency continued until July, and the fish expanded their distribution to barren brooks of the Mena and Shiribetsu River. The greatest upward movement recorded was a distance of 8. 8 km from the Mena River mouth to the Konanbu River. The abundance of fish in late July was estimated at 0. 57-2. 6/$m^2$ in the main stream and 0. 49-2. 5 in the tributaries. In late September, though estimates were not obtained, catches per unit effort showed extreme decrease of abundance in the main stream, except the uppermost part. In the tributaries, abundance decreased to 1/2 - 1/3 of late July; one case increased to 1. 2 times and another decreased 1/5. 6. Through the observation period, there was a tendency for the body lengths of mainstream-released fish of St. 5 - 9 to be larger than those of the tributary-released fish. Body lengths of main stream fish in late September showed similar or lesser values to those of late July.

13831. Matsukawa, Hiroshi, Teruo Ishida, and Tetsuhiko Tanaka. 1971. STUDIES ON THE PLANTING OF HATCHERY-CULTURED MASU SALMON FRY INTO STREAMS. 2. AN OBSERVATION ON DISPERSAL AND RESIDUARY OF JUVENILES IN THE SANNOSUKEZAWA-KAWA, A BRANCH OF THE MENA RIVER. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 19-27. In Japanese with English abstract.

An observation on dispersal and residuary of hatchery-cultured Masu fry was carried out in the Sannosukezawa brook during May to October, 1970. Dispersal was followed by means of fin-clipping. Numbers of resided fish were estimated by the method of marking and repeated fishing. A majority of the fry released at four sites in the brook dispersed downward from release and out of the brook, and only a few went upstream. In early July, some fish in the brook and from the Mena River shifted upstream until 1. 7 km from the mouth. The number had increased considerably by late July. From late July to late October the fish maintained their places. Numbers of fish per stream length were 3. 1-0. 9 per meter in late July, and the values were high in the lower part and low in the upper part. The values decreased to about one third of those of late July in late October. The released fry, mean fork length 4. 0 cm. grew to 9. 5 cm. in late October. Through the observation period, there was a tendency for the average and minimum lengths of frequencies to be larger in the upper part of the brook than in the lower part.

13832. Ishida, Teruo, Sunao Kosaka, and Koji Maekawa. 1971. A NOTE ON THE ECOLOGY OF JUVENILE MASU SALMON, Oncorhynchus masou IN A BROOK. SUPPLEMENT REPORT. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 29-34. In Japanese with English abstract.

Since observation in a brook near Hakodate was discontinued by environmental destruction, unpublished data are summarized in this report. Dispersal pattern of hatchery-cultured Masu fry released in 1969 was similar to that in 1968. Age 2 fish did not change their place of residence in the previous year, at least, by June, and shifted upward in the fall. Supplemental data on growth are presented.

13833. Nishida, Hideo, and Tetsuo Kobayashi (Hokkaido Univ. of Education, Iwamizawa, Japan). 1971. YOLK ABSORPTION AND TRANSLOCATION OF LIVER IN CHUM SALMON (Oncorhynchus keta) DEVELOPMENT. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 35-43. In Japanese with English abstract.

The formation and growth of the liver and yolk absorption of the chum salmon egg was investigated because of the absence of data on the same during artificial incubation and culture. The liver of alevins lies at the right of the body axis. During the growing period, the liver is transferred to the ventral and then to the left of the body axis. As a result, the liver of fry is located at the left of the body axis. In fry, the reduced yolk sac is connected with the blood vessels to the posterior-dorsal part of the liver, and it starts to disappear gradually, becoming a mere trace, and finally getting out of sight. The yolk absorption was examined according to different methods of incubation and culture. The yolk did not remain in the fry cultured in the gravels with spring water, but that of almost all the fry obtained from the other methods (in the trays with spring water and those with river water) remained even at stages of about 240 days after fertilization. Such preserved yolks varied in nature and in locations inside the body cavity.

13834. Hashimoto, Susumu. 1971. THE EFFECT OF TREATMENT WITH SALT WATER ON THE DEVELOPMENT OF CHUM SALMON, Oncorhynchus keta (Walbaum), EGGS----I. REMOVING THE UNFERTILIZED AND UNDEVELOPED EGGS FROM THE TRAYS USING SALT WATER. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 45-51. In Japanese with English abstract.

These experiments were initiated to delineate the consistency of the salt water solution that is used for removing worthless eggs, so as to clarify the effect of removing with salt water in regard to egg development. The sedimentation property of maldeveloped eggs resembles that of dead eggs in a salt water solution. In a 12% solution, it is possible to cull the maldeveloped eggs together with the dead eggs in 2-3 minutes after the start of treatment. The removing of the dead eggs will be nearly complete in a 13% solution, but it is necessary to continue the treatment for a long time. Moreover, living eggs, such as maldeveloped eggs, are likely to be mixed in with the dead eggs. It is considered that a salt solution of about 12-13% is sufficient for removing the worthless eggs.

13835. Hashimoto, Susumu. 1971. THE EFFECT OF TREATMENT WITH SALT WATER ON THE DEVELOPMENT OF CHUM SALMON, Oncorhynchus keta (Walbaum), EGGS----II. THE APPEARANCE OF DEAD EGGS AND UNUSUAL PHENOMENA OF INCUBATION. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 53-61. In Japanese with English abstract.

The present investigation was undertaken in order to elucidate the relationship between the impediment of development caused by the concentration of salt water and the period of treatment. The incubation rate in eggs treated with a salt solution was lowered by the occurrence of dead eggs and abnormal hatching. Moreover, the period from fertilization to the beginning of hatching was reduced, and the number of days from the first hatching until the last hatching increased. The salt which is absorbed on the surface of the eggs should be removed within eight minutes in order that the incubation rate in removing with salt water will not decrease. The removing of the worthless eggs with salt water should be carried out using a solution below a concentration of 12%, and the salt absorbed on the surface of the eggs should be removed within 5 minutes, so that the incubation period will not increase. It is considered that the relationship between the decrease of the period until the eggs first began to hatch and the increase of the period from the time when the first eggs hatched until the time the last eggs hatched is a compensatory relationship existing in the treatment within a fixed period. The above-mentioned shortening of the hatching period was considered to occur for the reason that the chorion is digested by the hatching enzyme according to phenomena described later. Namely, the moisture of the perivitelline liquid is dehydrated and the chorion press and destroy the enzyme gland, and enzyme dissolves in perivitelline. Abnormal hatching is considered to take place due to the partial digestion with the enzyme on the chorion. The part where the abnormal incubation began was confined to around the

head of the embryo in relation to the location of the enzyme gland on the embryo. The hastening of incubation, degree of occurrence of dead eggs, and abnormal hatching were considered to be closely related to the time of appearance of the enzyme gland the degree of development of the embryo.

13836. Hashimoto, Susumu. 1971. THE EFFECT OF TREATMENT WITH SALT WATER ON THE DEVELOPMENT OF CHUM SALMON, Oncorhynchus keta (Walbaum), EGGS----III. THE MOST SUITABLE TIME OF THE TREATMENT ON THE EYED STAGE. Sci. Rep. Hokkaido Salm. Hatch. No. 25, pp. 63-70. In Japanese with English abstract.

The purpose of this work is to clarify the influence of salt water treatment on egg development from the relation between the suitable time of treatment and the time of appearance of the hatching enzyme gland following the previous report. It is considered that the degree of abnormal hatching phenomena which occurred owing to the salt water treatment is closely related with the appearance and the growth of the hatching enzyme gland. The hatching enzyme was clearly present in an embryo which was allowed to develop for 47 days after fertilization when the incubation period was 62 days. The hatching enzyme gland was considered to appear during this period. Dead eggs and abnormal hatching did not occur, regardless of in what stage of development the eggs were treated, when the treatment period did not extend more than five minutes. The increase in the period from the first hatching until the last hatching of treated eggs was unrelated to the period of treatment. This period saw a remarkable increase in the progress of the development of eggs which were treated on the 53rd day after fertilization. When the eggs were treated within 35 to 53 days after fertilization, the number of days after fertilization until the last hatching increased according to the progress of egg development. This increase was unrelated to the treatment period. If we consider the feeding of fry, the removing of the worthless eggs with salt water should be done immediately after eye spots appear or just before hatching.

13837. Perepelkin, V. N. (Grozny Inspection of Zapkasprybvoda). 1970. THE OVERWINTERING PERIOD OF THE STURGEONS IN THE RIVER TEREK. (Zimoval'nyĭ period osetrovykh v R. Terek). Rybnoe Khozyaĭstvo No. 12, pp. 15-16. In Russian.

Investigations showed that for improvement of the wintering conditions of the sturgeons in the River Terek it is necessary to limit water utilization from the Tersko-Kumskiĭ Canal during this period and to prohibit sharp drawoffs of the upper water by the Hydrostation. Also, improvement is needed in purification of the waste waters at the plants of the Grozny Petrochemical Complex. -- Translated and abstracted by R. M. Howland.

13838. Kal'nibolotskiĭ, A. A. (GosNIORKh). 1971. ACCLIMATIZATION OF FOOD INVERTEBRATES - AN IMPORTANT SOURCE OF INCREASE IN FISHERY EFFICIENCY IN INLAND WATERS. (Akklimatizatsiya kormovykh bespozvonochnykh - Vazhnyĭ istochnik povysheniya effektivnosti rybnogo khozyaĭstva na vnutrennikh vodoemakh). Rybnoe Khozyaĭstvo No. 1, pp. 19-21. In Russian.

Experiments on the establishment of food invertebrates in reservoirs in order to raise the fish productivity of these waters were initiated in 1947. The stocking of food objects was carried out on a large scale in 1960-1962. During this period, 5-10 million specimens of mysids and polychaetes were introduced into different reservoirs. The fishery effect of the stocking appeared 3-4 years later as supplemental fish production. In all, 49 species of invertebrates, including 4 species of polychaetes, 10 - molluscs, 1 - decapod, 9 - mysids, 7 - cumaceans, and 18 - amphipods, were planted. Of the species listed, 26 acclimatized and 19 became massive in the reservoirs. In certain reservoirs (Kremenchug, Volgograd, Kuibyshev, Veselov, Dubossar, Gidigich, Kangaz, Mingechaur et al.) the established invertebrates became constant components in the feeding of many species of fish. Employing data of the Volgograd Division of GosNIORKh and including 7 more reservoirs on which there are catch data, we find that in 14 reservoirs about 55,000 centners of fish are caught due to the acclimatization of invertebrates. The

average annual catch for these reservoirs is 384,000 centners of fish. Thus, the supplemental catch due to enrichment of the food base amounts to 14% of the total catch of fish in these reservoirs. -- Translated and abstracted by R. M. Howland.

**13839.** Wickham, Donald A. (NMFS, Exploratory Fishing and Gear Res. Base, P. O. Box 1207, Pascagoula, Mississippi). 1970. COLLECTING COASTAL PELAGIC FISHES WITH ARTIFICIAL LIGHT AND 5-METER LIFT NET. Commercial Fisheries Review 32, No. 12, pp. 52-57; Commercial Fisheries Abstracts, 24(3): p. 12, 1971.

The National Marine Fisheries Service (NMFS) Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi, has used underwater lights and a large-diameter lift net to attract and capture live coastal pelagic fishes for experimental studies. The gear design and fishing methods evolved from our observations of the behavior of coastal pelagic fishes around underwater lights, and their responses to conventional lift nets. This article provides details for building and rigging the 5-meter (16.4 feet) diameter lift net--and the mounting platform used to position underwater lights and an echo sounder transducer over the net. The methods of fishing this gear and handling the live fish are described. (Auth.)

**13840.** Stucky, N. P. (Res. Div., Nebraska Game and Parks Commission, Lincoln, Nebraska). 1970. PESTICIDE RESIDUES IN CHANNEL CATFISH FROM NEBRASKA. Pesticides Monitoring Journal 4, No. 2, pp. 62-66; Commercial Fisheries Abstracts, 24(3): p. 32, 1971.

This study was part of a program to determine the statewide (Nebraska) extent of environmental contamination by pesticides. The basic objective of this particular work was to determine the levels of DDT (and its isomers and metabolites) and dieldrin in Nebraska watersheds using the catfish as the indicator organism. The channel catfish were collected during the summer of 1964. DDT and its metabolites (o, p'-DDT, p, p'-DDT, p, p'-DDD, and DDE) and dieldrin were determined in individual fat samples and composite blood samples from these fish. One hundred and seventy-eight fish from eighteen sites were collected. The level of pesticides in the fat of the fish was consistently higher than in the blood. Fat contained 2.2 to 92.2 ppm DDT, and 0.1 to 6.7 ppm dieldrin. Blood contained 0.01 to 0.16 ppm DDT, and 0.01 to 0.07 ppm dieldrin.

**13841.** Hansen, David J., and Alfred J. Wilson, Jr. (Bur. of Comm. Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Sta., Gulf Breeze, Florida). 1970. SIGNIFICANCE OF DDT RESIDUES FROM THE ESTUARY NEAR PENSACOLA, FLA. Pesticides Monitoring Journal, 4(2): 51-56; Commercial Fisheries Abstracts, 24(3): p. 33, 1971.

The researchers determined the amount of organochlorine pesticide residues in fish (Pelagic species: pinfish, croaker. Nonpelagic species: pigfish, silver perch, spot.) from the estuary near Pensacola, Florida, from April 1964 to November 1965. Also, they determined the rates of storage and retention of DDT in fish held under laboratory conditions. The pesticide content of the fish rarely was higher than 0.1 p.p.m. (whole fish basis) except in those collected from the lower estuary in the summer and fall when the amount of DDT and its metabolites reached 1.3 p.p.m. In the laboratory test, the fish were exposed to 0.1 p.p.b. of p, p'-DDT for 5 weeks. The DDT level in the fish increased up to the second week and remained nearly constant up to the end of the test period. The maximum concentrations in the fish were 38,000 times that in the test water. After the treated fish were held in pesticide-free water for 8 weeks, they lost 78 to 87% of their DDT. The level of DDD and DDE in the fish did not change either during exposure to DDT or during the flushing period (held in pesticide-free water for 8 weeks).

**13842.** Egusa, Syuzo (Dept. of Fish., Fac. of Agr., Univ. of Tokyo, Bunkyo-ku, Tokyo, Japan). 1970. NOTES ON SEX AND GROWTH OF EUROPEAN EELS IN FRESHWATER EEL-REARING PONDS. Bull. Jap. Soc. sci. Fish., 36(12): 1224-1225.

13843. Johnson, Donald W., and Sam Lew (Zool. Dept., Arizona State Univ., Tempe, Arizona). 1970. CHLORINATED HYDROCARBON PESTICIDES IN REPRESENTATIVE FISHES OF SOUTHERN ARIZONA. Pesticides Monitoring Journal, 4(2): 57-61; Commercial Fisheries Abstracts, 24(3): p. 34, 1971.

This paper contains data on the chlorinated hydrocarbon (pesticide) residues in fishes of the lower Colorado River Basin. The species examined were carp, channel catfish, green sunfish, threadfin shad, tilapia, and suckers (Sonoran and Gila). The concentrations of the residues in the fish were mostly in the parts per billion level. However, DDT and metabolites were found to be 187.5 p.p.m. Toxaphene was frequently found in the fish and at levels up to 172.9 p.p.m. Dieldrin was also found in significant concentrations. DDE was the principal residue.

13844. Wright, Kenneth J. (La Crosse, Wisconsin). 1970. THE 1967-1968 SPORT FISHERY SURVEY OF THE UPPER MISSISSIPPI RIVER. Contribution of the Upper Mississippi River Conservation Committee, 116 p.

1. The sport fishery of seven navigation pools of the Upper Mississippi River was surveyed in 1967-1968 with uniform guidelines first used in 1962-1963. Pools 4, 5, and 7 were studied from April 1, 1967 to March 31, 1968 while Pools 11, 13, 18, and 26 were studied only from April 1 to October 31, 1968. 2. Characteristics of both the angler and the catch were recorded. Interviews and observations provided data of value for comparison with previous and scheduled future surveys, and these data provide the basis for better understanding and management of this very valuable fishery resource. 3. For all seven pools combined, the species most often sought were walleye and sauger, followed by channel catfish, bluegill, and crappie. 4. Boat fishing accounted for 52 percent of the total fishing hours. Bank, barge, and ice fishing made up the remainder. 5. Over half of all anglers used private access to the river. 6. The catch was represented by 25 species or members of family groups. 7. Still-fishing with natural bait was the most popular method of fishing. 8. The highest catch per man hour of fishing was recorded for ice fishermen. 9. The ten most abundant species in the creel in order of occurrence were: bluegill, crappie species, freshwater drum, sauger, channel catfish, white bass, walleye, largemouth bass, yellow perch, and northern pike. 10. Projection of the actual data indicates that during the period of the survey and for the seven study pools, 454, 800 anglers fished for 1, 794, 583 hours to catch 1, 512, 209 fish weighing 1, 069, 712 pounds for a catch per manhour of 0.843 fish. 11. Based on an interim schedule of values now used as a common denominator by several Federal agencies, the total fishing recreational value for the seven pools was estimated to be $682, 200. This was obtained by multiplying the 454, 800 total fishing trips by $1.50, the value per fishing trip chosen from the interim schedule. The "1965 National Survey of Fishing and Hunting" reported that the average daily expenditure for freshwater sport fishing was $4.98 per day. The total fishing recreational value for the seven pools based on $4.98 per trip is approximately $2, 274, 000. 12. The study section was 22 percent of the total length of the river from Alton, Illinois, to Hastings, Minnesota. On this basis it was roughly projected that for the entire stretch from Alton to Hastings, 2, 067, 273 anglers fished 8, 157, 195 hours to catch 6, 873, 677 fish weighing a total of 4, 862, 327 pounds. It was also estimated that the river accommodated 2, 067, 273 fishing trips for a total fishing recreational value of $3, 100, 910 or $10, 336, 365 depending upon the schedule used. (Auth.)

13845. Yokote, Motoyoshi (Freshwater Fish. Res. Lab., Hino-Shi, Tokyo, Japan). 1970. SEKOKE DISEASE, SPONTANEOUS DIABETES IN CARP FOUND IN FISH FARMS - III. RESPONSE TO MAMMALIAN INSULIN. Contribution from Freshwater Fish. Res. Lab. No. 269; Bull. Jap. Soc. sci. Fish., 36(12): 1219-1223.

Responses of Sekoke, and normal carp to mammalian insulin were studied. Hypoglycemic effect of 5 IU/kg body weight insulin was not distinct in normal carp. A dose of 10 IU/kg body weight of insulin produced a marked hypoglycemia in normal carp 5 hours after the treatment. Blood sugar returned to near normal levels by 20-24 hours. During the period of the experiment, no convulsion was observed. Sekoke carp were less responsive to 10 IU/kg body weight of insulin than normals. (Auth. summ.)

13846. Yokote, Motoyoshi (Freshwater Fish. Res. Lab., Hino-Shi, Tokyo, Japan). 1970. SEKOKE DISEASE, SPONTANEOUS DIABETES IN CARP FOUND IN FISH FARMS - II. SOME METABOLIC ASPECTS. Bull. Jap. Soc. sci. Fish., 36(12): 1214-1218.

Blood sugar, glucose tolerance, urinary glucose and keton bodies, and blood pH were studied on 177 Sekoke carp and 179 normal controls. Fasting blood sugar value for 106 normal carp was 39.2 ± 0.8 mg/100 ml (Mean ± S.E.). On the other hand, almost all the diseased carp examined showed hyperglycemia, at a fasting level of 77.6 ± 3.6 mg/100 ml (n=61). Oral administration of glucose (0.5 g/kg) to normal carp evoked a hyperglycemia showing a maximum after one hour and returning to near normal levels 5-6 hours after glucose loading. Sekoke carp apparently showed a decreased glucose tolerance. A mode of their glucose tolerance curve was very similar to those described for diabetes mellitus in man and other animals. Occurrence of glycosuria and ketonuria were rare in the normal controls, but they were frequently detected in the diseased carp. About half the diseased carp examined showed acidotic states. (Auth. summ.)

13847. Watanabe, Takeshi, Fumio Takashima, Chinkichi Ogino, and Takashi Hibiya (Lab. of Fish. Biochem., Tokyo Univ. of Fish., Konan 4, Minato-ku, Tokyo, Japan). 1970. EFFECTS OF $\alpha$-TOCOPHEROL DEFICIENCY ON CARP - II. PROTEIN COMPOSITION OF THE DYSTROPHIC MUSCLE. Bull. Jap. Soc. sci. Fish., 36(12): 1231-1234.

Muscular dystrophy is one of the most striking features in carp fed either a diet deficient in $\alpha$-tocopherol or diet containing oxidized saury oil. The dystrophic muscle was found to be high in moisture and low in protein contents. The pattern of proteins in the dystrophic muscle was shown by fractionation and ultracentrifugal analyses to be considerably different from that of the normal muscle, especially in myofibrillar protein fractions soluble in 0.6 M KCl. Disappearance of the bulk of myosin and actomyosin from the muscle may be responsible for the fact that the dystrophic muscle, when ground, separated a considerable amount of juice and did not give a sticky paste, reflecting the poor water-binding capacity. It may be reasonably concluded that protein synthesis is more or less disturbed in tocopherol deficiency and that in muscular dystrophy of carp due to -tocopherol deficiency the loss of both myosin and actomyosin is remarkable.

13848. Numachi, Ken-ich (Ocean Res. Inst., Univ. of Tokyo, Nakano, Japan). 1970. POLYMORPHISM OF MALATE DEHYDROGENASE AND GENETIC STRUCTURE OF JUVENILE POPULATION IN SAURY Cololabis saira. Bull. Jap. Soc. sci. Fish., 36(12): 1235-1241.

A screening of malate dehydrogenase (MDH) isozyme composition of skeletal muscle from two population samples of saury juveniles collected at Suruga Bay revealed three phenotypes existing in high frequencies. The electrophoretic patterns and the frequency distributions of three types in the samples indicated that the MDH isozymes are dimers formed by random association of two subunits under the control of separate genetic loci, and three types are attributed to two alleles at the B locus of two loci coding for the enzyme. Both of the two samples of juveniles were composed of the three types in a stage of genetic equilibrium with respect to the B alleles, and each appeared to be a group of individuals having a certain genetic structure. (Auth. summ.)

13849. Ghittino, P. (Fish Disease Lab., Istituto Zooprofilattico Sperimentale Piemonte e Liguria, Via Bologna, 148 - 10154, Torino, Italy). 1970. REMARKS ON TWO QUATERNARY AMMONIA COMPOUNDS FOR THE CONTROL OF THE BACTERIAL GILL DISEASE IN HATCHERY RAINBOW TROUT FINGERLINGS. (Note su due ammoni quaternari nel trattamento della Malattia Branchiale Batterica delle trotelline d'allevamento). Riv. It. Piscic. Ittiopat., 5(4): 97-99.

The author tested two commercial quaternary ammonia compounds, Zephirol O.V. and Fardi 7, commonly available in Italy, for the control of bacterial gill disease in hatchery trout fingerlings. The compounds were diluted in ponds containing fish, at 20 ppm for one hour. The treatment was repeated 2-3 times a

week until fish reached a length of 12 cm and had improvements in environmental, hygienic, and dietetic conditions. The myxobacteria, which according to the author represent one of the various causes that can irritate the gills, inducing hyperplasia, were fully eliminated in 1-3 treatments. The fish recovered, but just the specimens without serious anatomic changes in the gills. The author suggests careful calculations of the concentration of the compounds to avoid any possible toxic effect in the fish. (Auth. summ.)

13850. Ghittino, P. (Fish Disease Lab., Istituto Zooprofilattico Sperimentale Piemonte e Liguria, Via Bologna, 148 - 10154, Torino, Italy). 1970. PRESENT STATUS OF WHIRLING DISEASE IN ITALIAN TROUT FARMS. Riv. It. Piscic. Ittiopat., 5(4): 89-92.

Whirling Disease (WD) of salmonids, caused by Myxosoma cerebralis (Protozoa: Myxosporida), was first reported in Italy in 1950. It is not possible to establish the exact source of infection but since Italy was importing many live trout eggs and fingerlings (both rainbow and brown) from European countries affected by WD (Denmark, Germany), it is not improbable that the disease was introduced through such imports. During the early 1950's WD caused severe damage in Italian trout farms. Since then its occurrence and severity have been regressing until at the present time it is rather insignificant because most of the trout farmers have learned how to control it. However, WD is a constant threat in trout hatcheries which have not adopted modern methods of fish culture. The campaign against WD in Italy is voluntary. At first, we tried to control it by including Stovarsol (Acetarsone) in trout diets and disinfecting the freshly drained ponds with calcium cyanamide. These methods effected only partial control. At present we still use separate stations where they are reared in concrete raceways supplied by spring water free from the organism. When these fish reach 5-6 cm and are resistant to WD, they are stocked in the earthen ponds as is done in Denmark. It must be remembered that, although fish reared thusly show no symptoms, they are suspected carriers until demonstrated spore-free. (Auth.)

13851. Ghittino, P., and G. Arcarese (Fish Disease Lab., Istituto Zooprofilattico Sperimentale Piemonte e Liguria, Via Bologna, 148 - 10154, Torino, Italy). 1970. EXTENSIVE CONTROL OF FISH-ARGULOSIS AND -LERNAEOSIS BY PERMANENT TREATMENTS OF MASOTEN (R). (Argulosi e Lerneosi dei pesci trattate in extenso con Masoten (R)). Riv. It. Piscic. Ittiopat., 5(4): 93-96.

The authors performed large-scale experiments with Masoten (R) to control argulosis and lernaeosis in some fishes in Italy. Tests were accomplished during summer at water temperatures higher than 21-24°C, on rainbow trout (Salmo gairdneri) in freshwater sport-fishing ponds and on European eel (Anguilla anguilla) kept in brackish-water fenced lagoons. In both cases, the parasitosis was inducing severe damage or extensive losses in the fish. The drug appeared effective at 0.25-0.30 ppm, in long-term treatments, preferably repeating it after one or more weeks. Both Argulus foliaceus and A. giordanii were easily eliminated from the fish after but one treatment. Lernaea cyprinacea and L. esocina required a longer period of action. They detached from the skin leaving typical ulcers within one to two weeks. The authors suspect that Masoten may control even adult Lernaea, which are obviously protected by a chitinous envelope. Further research is in progress to ascertain the effect of such a drug on the aquatic biomass and on its residues in fish and in ponds. (Authors summ.)

13852. Kaesler, Roger L., John Cairns, Jr., and John M. Bates (Dept. of Geol., Univ. of Kansas, Lawrence, Kansas). 1971. CLUSTER ANALYSIS OF NON-INSECT MACRO-INVERTEBRATES OF THE UPPER POTOMAC RIVER. Hydrobiologia, 37(2): 173-181.

A series of limnological surveys carried out from 1956 until 1965 were made in the vicinity of the Dickerson Plant of the Potomac Electric Power Company by the Limnology Department of the Academy of Natural Sciences of Philadelphia. These surveys were made at various stages of growth of the power station and at high and low water levels of the river. Cluster analyses were made of the non-insect

macro-invertebrates in order to provide a rapid and explicit means of analyzing the data, particularly relationships among aggregations of species. On the basis of the cluster analysis of data on occurrence and distribution of non-insect macro-invertebrates, no changes in the environment of the Upper Potomac River can be ascribed to the operation of the Dickerson Plant of the Potomac Electric Power Company. This conclusion agrees with the other results obtained by analyses of protozoan, algal, fish, and insect species. Jaccard coefficients among aggregates of the invertebrates included in this study are generally higher than those for the other groups of organisms studied except for fish. This may be the result of high tolerance of some of the species to a wide range of environmental conditions. (Authors summ.)

**13853.** French, Robert R., Richard G. Bakkala, Masanao Osako, and Jun Ito (NMFS Biol. Lab., Seattle, Washington). 1971. DISTRIBUTION OF SALMON AND RELATED OCEANOGRAPHIC FEATURES IN THE NORTH PACIFIC OCEAN, SPRING 1968. U. S. Dept. Commerce, NOAA, NMFS, Special Scientific Report - Fisheries No. 625, 22 p.

Japanese and United States research vessels made a cooperative research cruise. Differences in distribution of salmon were examined by species, by maturity, and by age group. Sockeye salmon, Oncorhynchus nerka, were in the more northerly waters and pink salmon, O. gorbuscha, in the more southerly waters, whereas chum salmon, O. keta, were more widely distributed and in all waters occupied by other species. The proportion of older ages decreased from north to south; immature sockeye and chum salmon were generally restricted to the more southern waters and maturing fish to the more northern waters. The distribution of larval fish, which at times serve as food for salmon, varied by group; Hexagrammidae were in all waters occupied by salmon whereas larvae of Hemilepidotus and Bathymaster were taken only in the northern areas and Myctophidae larvae only in the southern areas occupied by salmon. (Authors)

**13854.** Whitt, Gregory S., and Frances S. Maeda (Dept. of Zool., Univ. of Illinois, Urbana, Illinois). 1970. LACTATE DEHYDROGENASE GENE FUNCTION IN THE BLIND CAVE FISH, Anoptichthys jordani, AND OTHER CHARACINS. Biochemical Genetics No. 4, pp. 727-741.

The functions of the genes encoded for lactate dehydrogenase (LDH) in six genera of characins (teleost) were examined by electrophoretic and immunochemical analyses of the LDH isozymes. The characins possess the LDH A and B loci present in all vertebrates. The eyeless Mexican cave fish (Anoptichthys jordani) and other characins possessing normal eyes, e.g., Mexican tetra (Astyanax mexicanus, which is able to hybridize with the cave fish), blue tetra (Mimagoniates microlepis), sailfin tetra (Crenuchus spilurus), head and tail light tetra (Hemigrammus ocellifer), and the piranha (Serrasalmus spilopleura), all lack the function of a third LDH locus (the E locus) present in many teleosts which codes for a distinctive isozyme synthesized in the nervous system, particularly in the neural retina. (Authors)

**13855.** Moore, William S., Robert Rush Miller, and R. Jack Schultz (Biol. Sci. Group, Univ. of Conn., Storrs, Connecticut). 1970. DISTRIBUTION, ADAPTATION AND PROBABLE ORIGIN OF AN ALL-FEMALE FORM OF Poeciliopsis (PISCES: POECILIIDAE) IN NORTHWESTERN MEXICO. Evolution, 24(4): 789-795.

The distribution of the all-female "species" P. monacha-occidentalis over the range of its "host species" P. occidentalis is presented. The all-female form achieves greatest concentration at the southern limit of its range in the Rio Mayo and is successively diminished in the four northerly drainages. Within a given drainage the proportion of P. monacha-occidentalis increases from very low levels at its western extent, along the eastern edge of the Sonoran Desert, to maximum levels midway between the eastern and western boundaries of its range. To the east of this maximum, considerable localized fluctuation in proportional levels of P. monacha-occidentalis occurs. The hypothesis which most parsimoniously explains the origin and distribution of the unisexual form, P. monacha-occidentalis is: 1) P. monacha-occidentalis arose from P. monacha-lucida, a unisexual form

of a more southern origin which has migrated north into the range of P. occidentalis. 2) It sustains itself by mating with males of the indigenous P. occidentalis. In so doing, it inherits not only some of its morphological characters but also some of its ecological requirements. All-femaleness and the maternal genome are retained, however, via hybridogenesis. 3) The level at which P. monacha-occidentalis females are found in a population is probably determined by the slight differences in niche requirements of P. monacha-occidentalis and the host species P. occidentalis. A stable equilibrium between the two forms appears to exist within a given drainage and possibly within local populations. However, the causative factors in this equilibrium cannot be resolved from these data. (Authors summ.)

13856. Idler, D. R., and G. B. Sangalang (Fish. Res. Bd. Canada, Halifax Lab., P. O. Box 429, Halifax, Nova Scotia, Canada). 1970. STEROIDS OF A CHONDROSTEAN: IN-VITRO STEROIDOGENESIS IN YELLOW BODIES ISOLATED FROM KIDNEYS AND ALONG THE POSTERIOR CARDINAL VEINS OF THE AMERICAN ATLANTIC STURGEON, Acipenser oxyrhynchus Mitchell. J. Endocrin., 48(4): 627-638; Comm. Fish. Abstr., 24(6): p. 4, 1971.

In this report, the authors present direct evidence of steroidogenesis by sturgeon tissue. The enzymes necessary for steroid transformation and cleavage of the cholesterol side-chain are present in the yellow bodies they isolated from the kidneys and from along the posterior cardinal veins. When the sturgeon's yellow bodies were incubated with (16-$^{3}$H) pregnenolone and (4-$^{14}$C) progesterone, cortisol was formed in yields of 54.3% of the $^{3}$H and 55.1% of the $^{14}$C precursor activities. Although double-labeled cortisone, corticosterone, 11-deoxycortisol, 17$\alpha$-hydroxyprogesterone, and progesterone were isolated as transformation products, the yields were much lower. No 11-deoxycorticosterone, aldosterone, or 1$\alpha$-hydroxycorticosterone was detected. When the yellow bodies were incubated with (7-$^{3}$H) cholesterol, pregnenolone (0.43%), progesterone (0.091%), 17$\alpha$-hydroxyprogesterone (0.023%), cortisol (0.061%), cortisone (0.004%), corticosterone (0.001%), and 11-deoxycortisol (0.047%) were isolated as labeled transformation products. In this instance, too, no 11-deoxycorticosterone, aldosterone, or 1$\alpha$-hydroxycorticosterone was detected. The authors identified all the steroid products by their isopolarity with authentic steroids. Their identification method was repeated chromatography and recrystallization of free steroids or their derivatives, or both (after addition of authentic radio-inert steroids), to constant $^{3}$H:$^{14}$C isotype ratios.

13857. Stainton, Michael P. (Fish. Res. Bd. Canada, Freshwater Inst., 501 University Crescent, Winnipeg 19, Manitoba, Canada). 1971. SYRINGE PROCEDURE FOR TRANSFER OF NANOGRAM QUANTITIES OF MERCURY VAPOR FOR FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY. Analytical Chemistry, 43(4): 625-627; Comm. Fish. Abstr., 24(6): p. 15, 1971.

This article describes a method, using a syringe, for transferring nanogram quantities of mercury vapor (in equilibrium with reducing solution) for the cuvette in the determination of mercury by flameless atomic absorption spectrophotometry. The procedure involves the use of a small-volume (3 cc.) cuvette, thus a small sample can be used. The method was tested by analyzing the mercury content of northern pike. The method offers excellent precision with a relative standard deviation of 1% at the 20 µg. of mercury per liter level. About 40 to 60 samples per hour can be run.

13858. Saito, A., and L. W. Regier (Fish. Res. Bd. Canada, Halifax Lab., Halifax, Nova Scotia, Canada). 1971. PIGMENTATION OF BROOK TROUT (Salvelinus fontinalis) BY FEEDING DRIED CRUSTACEAN WASTE. J. Fish. Res. Bd. Canada, 28(4): 509-512.

Shrimp and crab wastes were fed to yearling brook trout for 12 weeks. Diets containing 20 and 30% shrimp waste, 20% crab waste, and 0.004% canthaxanthin were compared with a commercial trout diet. The carotenoid contents of the flesh and skin were highest with the canthaxanthin-fed fish, but the 20% shrimp-waste-fed fish had the most desirable color visually within the feeding period used. (Authors)

**13859.** Idler, D. R., and M. J. O'Halloran (Fish. Res. Bd. Canada, Halifax Lab., P. O. Box 429, Halifax, Nova Scotia, Canada). 1970. STEROIDS OF A CHONDROSTEAN: IDENTIFICATION OF INTERNAL TISSUE IN THE AMERICAN ATLANTIC STURGEON, Acipenser oxyrhynchus Mitchell, BY HISTOLOGICAL AND HISTOCHEMICAL METHODS. J. Endocrin., 48(4): 621-626; Comm. Fish. Abstr., 24(6): p. 3, 1971.

The authors studied the anatomical distribution and the histology of the adrenocortical tissue of two male and one female sturgeon. In addition, they studied the tissue's steroidogenic potential, using the hydroxysteroid-dehydrogenase technique for demonstrating the presence of 3$\beta$-, 3$\alpha$-, 11$\beta$-, 20$\beta$-, and 20$\alpha$-hydroxysteroid dehydrogenase (HSD). The histology of the yellow bodies scattered throughout the kidney tissue and posterior cardinal veins of the sturgeon resembled that of interrenal tissue rather than that of corpuscles of Stannius. The 3$\beta$-HSD activity in the yellow bodies was intense when dehydroepiandrosterone and pregnenolone were used as substrates. When androsterone was the substrate, the 3$\alpha$-HSD activity was very weak; and when cortisol and corticosterone were the substrates, 11$\beta$-HSD activity was nonexistent. No 20$\alpha$- or 20$\beta$-HSD activity was observable when 20$\alpha$- and 20$\beta$-hydroxyprogesterone were used, respectively, as substrates. The authors conclude that the numerous yellow bodies scattered throughout the sturgeon's kidney and posterior cardinal veins are true interrenal tissue.

**13860.** Loeb, Howard A., and Robert Engstrom-Heg (Bur. of Fish Lab., N. Y. State Conservation Dept., Livingston Manor, New York). 1970. TIME-DEPENDENT CHANGES IN TOXICITY OF ROTENONE DISPERSIONS TO TROUT. Toxicol. appl. Pharmacol., 17(3): 605-614; Comm. Fish. Abstr., 24(6): p. 25, 1971.

Emulsified rotenone preparations are commonly used to remove unbalanced, ill-adapted, or stunted fish populations from lakes and streams. The typical preparation is photochemically unstable, readily undergoing oxidative decomposition in the presence of strong light and high temperatures. Thus, treated waters can become nontoxic to fish in a matter of days or weeks. Where rotenone-bearing waters enter domestic water supplies, more rapid detoxification is required. To help meet this need, the authors investigated the detoxification phenomenon in an effort to establish standards for the preparation and use of rotenone dispersions having time-constant toxicity. Freshly prepared aqueous dispersions of 5% emulsified rotenone became more toxic to trout upon standing (probably reflecting a transition from the colloidal to the dissolved state), the toxicity increasing rapidly at elevated temperatures. After the initial increase at 47°F, toxicity remains almost constant for at least 10 days. At 65°F, 1 p. p. m. of the dispersion may become suddenly nontoxic to the fish at any time between 2 and 7 days after preparation; but when an additional 1 p. p. m. is added after detoxification, a second rapid detoxification occurs--this time after a shorter latent period. A longer latent period in dispersions prepared with sterilized water suggests that the catalytic substance which probably accumulates and causes the breakdown of the rotenone may be an enzyme or other microbial product. The authors conclude that the time that elapses following preparation must be considered in any work with rotenone dispersions--and probably with other colloidal toxicants. At 65°F, no major changes in toxicity will occur in dispersions that are used within 1 to 48 hr. of preparation; at 47° or 48°F, little change will occur if the dispersion is used between 3 hr. and 10 days of preparation.

**13861.** Khan, N. Y., and S. U. Qadri (Dept. of Biol., Univ. of Ottawa, Ottawa, Ontario, Canada). 1971. INTRASPECIFIC VARIATIONS AND POSTGLACIAL DISTRIBUTION OF LAKE CHAR, (Salvelinus namaycush). J. Fish. Res. Bd. Canada, 28(4): 465-476.

A morphometric and meristic study of 325 lake char (Salvelinus namaycush) from over its range of distribution showed different gene pools. The similarities and differences observed among lake char of various primary ocean drainages and among various populations of lake char within these drainages suggested that the species survived the last glaciation in unglaciated Alaska and Yukon, possibly other unglaciated northern areas, and at least three refugia in the south, the Atlantic, Upper Mississippi, and Upper Missouri. (Authors)

13862. Bulkley, Ross V. (Iowa Coop. Fish. Unit, Iowa State Univ., Ames, Iowa). 1970. CHANGES IN YELLOW BASS REPRODUCTION ASSOCIATED WITH ENVIRONMENTAL CONDITIONS. Iowa State Journal of Science, 45(2): 137-180.

Gillnet collections of yellow bass, Morone mississippiensis, were made from April 1967 to September 1968 at Clear Lake, Iowa, to determine the normal reproductive cycle and variations in fecundity that could be related to changes in food supply and water temperatures. A major mortality from Aeromonas salmonicida occurred in May 1968 and allowed documentation of changes in body condition, fecundity and success of reproduction during the year preceding a mass mortality from furunculosis. Spawning was initiated during mid-May in 1967 and late April in 1968 when water temperatures approached 15°C after a rapid temperature rise of 3.5 to 4.5°C over several days. At spawning time, ovaries of adult bass constituted up to 16 percent body weight and testes up to 8 percent body weight. Maturing ova had a mean diameter of 0.4 mm in the preserved state when fish commenced spawning. Fresh ovulated ova averaged 0.8 $\pm$ 0.11 mm in diameter. Wide variation in effective fecundity was evident among mature females of similar length. Although 50 percent of the variation in fecundity could be attributed to body length in 1967, the relation was not significant in 1968 ($r = 0.32$). In 1967, mature females contained an average of 560 mature ova per mm total body length in contrast to 276 ova in 1968. In terms of body weight, the average female produced 835 ova per gram body weight in 1967 but only 350 in 1968. The reduction in fecundity was attributed to poor body condition in 1968. Females measuring 200 mm total body length weighed approximately 137 g in 1967 at spawning time but only 115 g in 1968. Atresia of developing ova was estimated at 20 percent during the period from December to May and was attributed to poor nutrition. Ova retention after spawning in 1967 was approximately 34 percent of total ova production. In 1968 most fish died shortly after initiation of spawning, with a minimum number of ova shed. Reproduction success in 1968 determined by standardized seining of young-of-the-year bass was 1 percent of the 1967 level (77 vs 7015). Young-of-the-year yellow bass were a major food item of adult bass during late summer and autumn when gonadal development was initiated. At other times adult bass ate invertebrate food similar to that of young bass. Mesenteric fat decreased steadily with gonadal development in both sexes from March to May 1968 and reached zero levels at spawning time. Insufficient food, as reflected by poor body condition, coupled with fluctuating spring water temperatures seemingly allowed furunculosis to reach epizootic proportions when spawning commenced in 1968. The yellow bass population was decimated by the disease, but mortality of other species was not observed. Catch per gillnet hour decreased from 2.158 bass in mid-May to 0.025 in mid-June and 0 by the end of July. (Auth.)

13863. van Overbeeke, A. P., and J. R. McBride (Fish. Res. Bd. Canada, Vancouver Lab., Vancouver 8, British Columbia, Canada). 1971. HISTOLOGICAL EFFECTS OF 11-KETOTESTOSTERONE, 17$\alpha$-METHYLTESTOSTERONE, ESTRADIOL, ESTRADIOL CYPIONATE, AND CORTISOL ON THE INTERRENAL TISSUE, THYROID GLAND, AND PITUITARY GLAND OF GONADECTOMIZED SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 28(4): 477-484.

Effects of two androgens, two estrogens, and cortisol in gonadectomized sockeye salmon (Oncorhynchus nerka) were investigated. Males were injected with 11-ketotestosterone, 17$\alpha$-methyltestosterone, and cortisol for 4 or 7 weeks. Females were injected with estradiol, estradiol cypionate, or cortisol for 8 weeks. Both the androgens and the estrogens caused interrenal hypertrophy. The effect of 17$\alpha$-methyltestosterone was stronger than that of 11-ketotestosterone, and of the two estrogens used, estradiol cypionate exerted the most marked effect. Cortisol brought about a slight atrophy of the interrenal tissue. A pronounced histological activation of the small thyroid follicles was induced by the two androgens. The estrogens exerted no visible effect on the thyroid gland, and cortisol treatment caused a slight reduction in the height of the follicular epithelium. In the gonadectomized control fish of both sexes, gonadotrophs were small and practically all devoid of granules. All four sex steroids induced the appearance of many granulated PAS-positive gonadotrophs, particularly in the anterior part of the proximal pars distalis. This effect is considered on activation of the gonadotrophs. Cortisol

administration induced pronounced degranulation and atrophy of the coritcotrophs and this effect was strongest in the males. Neither the androgens nor the estrogens visibly affected the corticotrophs. (Authors)

**13864.** McBride, J. R., and A. P. van Overbeeke (Fish. Res. Bd. Canada, Vancouver 8, British Columbia, Canada). 1971. EFFECTS OF ANDROGENS, ESTROGENS AND CORTISOL ON THE SKIN, STOMACH, LIVER, PANCREAS, AND KIDNEY IN GONADECTOMIZED ADULT SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 28(4): 485-490.

A study was made of the histological changes occurring in the skin, stomach, liver, pancreas, and kidney of adult gonadectomized male and female sockeye salmon in response to hormone treatments. The males received 11-ketotestosterone, 17α-methyltestosterone or cortisol for 4 or 7 weeks, and the females received estradiol, estradiol cypionate, or cortisol for 8 weeks. In the males, androgen injection evoked a highly significant increase in the thickness of the epidermis, a marked atrophy of the stomach, and a degeneration in the liver and kidney. In the pancreas, the exocrine portion showed characteristics of cytolysis in the acini, whereas the islets of Langerhans were hypertrophied. These changes were generally more pronounced after 7 weeks than after 4 but, in the skin, no further increase in the thickening of the epidermis was noted after the 4th week of treatment. No differences between responses of these tissues to 11-ketotestosterone and 17α-methyltestosterone were detected. Estrogen administration in the females evoked similar, albeit weaker, responses in the skin, stomach, pancreas, and kidney than those recorded in the androgen-treated males. The liver of the females exhibited the characteristics of a hyperactive organ, which probably reflects estrogen-induced vitellogenesis. The effects of cortisol were similar in both sexes: little, if any, change was noted in the skin; atrophy or degeneration was observed in the stomach, liver, kidney, and in the exocrine portion of the pancreas, and the islets of Langerhans were hypertrophied. The cortisol-induced alterations were not, however, as pronounced as those noted in either the androgen- or estrogen-treated fish. These changes are discussed in relation to the changes observed in normal sexually maturing and reproducing Pacific salmon. (Authors)

**13865.** Saunders, R. L., and A. M. Sutterlin (Fish. Res. Bd. Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1971. CARDIAC AND RESPIRATORY RESPONSES TO HYPOXIA IN THE SEA RAVEN, Hemitripterus americanus, AND AN INVESTIGATION OF POSSIBLE CONTROL MECHANISMS. J. Fish. Res. Bd. Canada, 28(4): 491-503.

Responses of the sea raven (Hemitripterus americanus) to hypoxia consisted of an increase in rate and amplitude of breathing and an increase in dorsal and ventral aortic pressure. Changes in heart rate seldom occurred. Bilateral transection of cranial nerves IX and X resulted in a fall in dorsal aortic $PO_2$ to a sustained low level but did not alter the dorsal and ventral aortic blood pressure or breathing responses induced by hypoxia. Pressure changes in the opercular cavity during breathing seldom exceeded .5 cm $H_2O$ and rarely exceeded 1 cm $H_2O$ under extreme hypoxia. There were no obvious differences in opercular pressure wave forms before and after bilateral section of nerves IX and X. An artificial "heart-gill" machine was devised with which blood $PO_2$ could be altered outside the fish and the blood perfused into either the dorsal or ventral aorta. Breathing amplitude was increased by perfusing blood of low $PO_2$ into the dorsal aorta. While maintaining dorsal aortic $PO_2$ high and constant, increases in breathing amplitude were induced by low ambient $PO_2$ levels. Vasomotor changes in blood pathways other than the gills probably contribute to the changes in blood pressure observed during hypoxia. Preliminary evidence for both central and peripheral sites of oxygen receptor activity is provided. (Authors)

**13866.** Davis, R. M., and O. C. Fenderson. (Maine Dept. of Inland Fish. and Game, Bangor, Maine). 1971. HISTOLOGICAL COMPARISONS OF THE ADRENAL-CORTICAL CELLS OF HATCHERY AND WILD LANDLOCKED ATLANTIC SALMON (Salmo salar). J. Fish. Res. Bd. Canada, 28(4): 505-508.

No differences were found in mean diameters of adrenal-cortical cell nuclei

between hatchery part of landlocked Atlantic salmon (Salmo salar) killed immediately after removal from hatchery rearing pools and wild parr electrofished in two streams, and between hatchery and wild parr held for various periods in an outdoor stream aquarium simulating natural conditions. The similarities suggested that the wild and hatchery parr were similar in physiological response to environmental stress. In both hatchery and wild parr, the diameters differed at different times, indicating a downward trend from May to August in the one year of the study. No consistent relation was found between nucleus diameter and social behavior. (Authors)

**13867.** Bilton, H. T. (Fish. Res. Bd. Canada, Biol. Sta., Nanaimo, British Columbia, Canada). 1971. A HYPOTHESIS OF ALTERNATION OF AGE OF RETURN IN SUCCESSIVE GENERATIONS OF SKEENA RIVER SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 28(4): 513-516.

Egg weight of Scully Creek and Lower Babine River sockeye salmon (Oncorhynchus nerka) was positively correlated with length and, usually, age of the female parent. Egg weight was positively correlated with initial size and subsequent growth of juveniles, at least up to 3 months of age. Examination of scales indicated juvenile growth in the lake and ocean was inversely related to age at maturity. Hence it was hypothesized that the large age 1.3 sockeye spawners tend to produce progeny that mature as smaller age 1.2 fish, which in turn give rise to progeny that mature as larger age 1.3 fish, and so on; an alternation in age of return of successive generations occurs. (Auth.)

**13868.** Evelyn, T. P. T. (Fish Res. Bd. Canada, Biol. Sta., Nanaimo, British Columbia, Canada). 1971. FIRST RECORDS OF VIBRIOSIS IN PACIFIC SALMON CULTURED IN CANADA, AND TAXONOMIC STATUS OF THE RESPONSIBLE BACTERIUM, Vibrio anguillarum. J. Fish. Res. Bd. Canada, 28(4): 517-525.

First proven outbreaks of piscine vibriosis in Canada are recorded. The disease occurred in four species of Pacific salmon that were being cultured in sea water at facilities in Nanaimo and West Vancouver, B. C., and both the disease and the causative bacterium (identified as Vibrio anguillarum) are described. A brief review of the literature on Vibrio fish pathogens susgests that most of these organisms might reasonably be assigned to the species V. anguillarum, and a tentative archtype for the species is described. Before the species is formally recognized, however, a large-scale comparative study is needed to provide the uniform information that is now lacking for individual strains of this species and to determine whether in fact it can be distinguished from other heterotrophic marine vibrios, many of which are commensal with marine animals. (Auth.)

**13869.** Fujihara, M. P., and F. P. Hungate (Pacific Northwest Labs., Battelle Memorial Inst., Richland, Washington). 1971. Chondrococcus columnaris DISEASE OF FISHES: INFLUENCE OF COLUMBIA RIVER FISH LADDERS. J. Fish. Res. Bd. Canada, 28(4): 533-536.

Columbia River fish ladders were surveyed as a possible ecological niche for Chondrococcus columnaris, the causative agent for columnaris disease of fishes. Water samples from Bonneville, McNary, Priest Rapids, and Rocky Reach fish ladders during periods of warm-water temperature and high population density of fishes showed C. columnaris levels of from 0.06 to 4.1 organisms/ml. Samples taken upstream or downstream from the ladders were consistently negative. Average agglutinating titers and incidence of C. columnaris infection in largescale suckers were higher at the Bonneville ladder than at a site several miles downstream. Coho salmon from an upper-river fish ladder (Rocky Reach) showed a higher incidence of infection and greater antibody production than at the downriver Bonneville ladder. It is concluded that fish-ladder facilities on the Columbia River are important sites for repetitive exposure of anadromous salmonids to C. columnaris. (Authors)

**13870.** Warner, Kendall (Maine Dept. of Inland Fish. and Game, Bangor, Maine). 1971. EFFECTS OF JAW TAGGING ON GROWTH AND SCALE CHARACTERISTICS OF LANDLOCKED ATLANTIC SALMON, Salmo salar. J. Fish. Res. Bd. Canada, 28(4): 537-542.

Recapture of 165 annual and biennial spawners of landlocked Atlantic salmon (Salmo salar) from 1239 fish tagged on the spawning grounds from 1953 to 1955 at the Fish River Lakes, Maine, showed that jaw-tagged females grew significantly slower than untagged females of identical ages and cycles. For most maturing male salmon, growth increments were not significantly reduced by jaw tagging. A tendency for decreased growth increments with increase in age was apparent for both tagged and untagged fish. Recognizable annuli were formed on the scales of 77-100% of 97 male salmon and of 74-97% of 187 female salmon between tagging and recapture. A significantly smaller percentage of females (74%) than males (100%) at large 1 year and recaptured on the spawning grounds had formed a recognizable annulus, but there was no significant difference between females (86%) and males (91%) recaptured by anglers. The significantly lower annulus recognition for annual female spawners was attributed to their demonstrated slower growth rate and possibly resorption of minimal marginal scale growth. Spawning checks were recognizable on the scales of 69-100% of 97 males and 49-78% of 187 females recaptured. Male salmon recaptured on the spawning grounds formed a significantly higher percentage of recognizable spawning checks than females (both annual and biennial spawners), but there were no significant differences between sexes for angler-recaptured fish. Lower reliability in spawning check recognition for females was attributed to less severe marginal resorption resulting in no spawning check being formed, or obliteration of previous spawning checks by resorption of the small amount of marginal scale increment made by some annually spawning females, or both. (Auth.)

**13871.** Davies, Ronald W. (Dept. of Biol., Univ. of Calgary, Calgary, Alberta, Canada). 1971. A KEY TO THE FRESHWATER HIRUDINOIDEA OF CANADA. J. Fish. Res. Bd. Canada, 28(4): 543-552.

A key to the freshwater leeches (Hirudinoidea) of Canada and the bordering states of the USA is presented, together with notes on their important diagnostic features. (Auth.)

**13872.** Parsons, L. S., and V. M. Hodder (Fish. Res. Bd. Canada, Biol. Sta., St. John's, Newfoundland, Canada). 1971. MERISTIC DIFFERENCES BETWEEN SPRING- AND AUTUMN-SPAWNING ATLANTIC HERRING (Clupea harengus harengus) FROM SOUTHWESTERN NEWFOUNDLAND. J. Fish. Res. Bd. Canada, 28(4): 553-558.

Numbers of vertebrae, gill rakers, and of pectoral, anal, and dorsal fin rays of spring- and autumn-spawning Atlantic herring (Clupea harengus harengus Linnaeus) in 10 samples from the coastal waters of southwestern Newfoundland were compared. There was no significant difference ($P > 0.05$) between mean vertebral numbers of spring and autumn spawners. Mean numbers of gill rakers and of pectoral, anal, and dorsal fin rays were all higher ($P < 0.01$) for autumn spawners than for spring spawners with gill-raker and pectoral fin-ray numbers exhibiting the greatest degree of difference. It is suggested that the differences in fin-ray numbers between spring and autumn spawners are related to water temperatures during larval development and to differences in developmental rates of spring- and autumn-hatched larvae. (Authors)

**13873.** O'Hara, James (Biol. Dept., Antioch Coll., Yellow Springs, Ohio). 1971. A CONTINUOUSLY MONITORED RESPIRATION CHAMBER FOR FISH. Water Research, 5(4): 143-145. Published by Pergamon Press, Great Britain.

An apparatus that provides a continuous recording of the respiration rates of fishes is described. The respirometer uses the flowing water technique and provides extremely reliable determinations of respiration rates to be made on small to medium sized fish. (Auth.)

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The Department works to assure the wisest choice in managing all our resources so that each shall make its full contribution to a better United States now and in the future.

# A CENTURY OF
# FEDERAL FISH CONSERVATION